November 10, 2005

Technical Report

Drinking Water System
at the
Kashechewan First Nation

Ontario

Ministry of the Environment

PIBs 5445

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Acknowledgements

The Ministry of the Environment would like to thank Chief Leo Friday and the Band Council of the Kashechewan First Nation for the cooperation shown to the members of the Expert Technical Team during their time in their community.

The Expert Technical Team was assisted in its work by staff from the Kashechewan Drinking Water and Sewage Systems, and the contracted water treatment plant operator, Northern Waterworks Inc. Their help was most appreciated.

In addition, representatives of Indian and Northern Affairs Canada (INAC), Health Canada and Public Works Canada provided ongoing assistance to the Ministry.

Introduction

This document is a technical assessment prepared by the Ontario Ministry of the Environment on the drinking water system of the Kashechewan First Nation. The intent of this report is to provide advice and recommendations to the Chief and Band Council of the Kashechewan First Nation and the Department of Indian and Northern Affairs regarding the reliable delivery of potable water to the community.

The report focuses on the results of the assessment of the drinking water system. The assessment provides an indication of the performance of the drinking water system relative to requirements in Ontario for municipal drinking water systems. An assessment of the sewage collection system and sewage treatment facility was undertaken as well because of their potential impact on the source of the community's drinking water.

The drinking water and sewage systems of the Kashechewan First Nation fall under federal jurisdiction. The Kashechewan First Nation is the owner and, as of October 15, 2005, Northern Waterworks Inc. is the contracted operating authority for the Kashechewan Drinking Water System.

The Expert Technical Team recommended a number of actions to safeguard Kashechewan's drinking water. Key recommendations focus on:

- upgrades required to the physical works and treatment processes
- operator presence and training
- implementing procedures for reporting, notification and corrective actions in the event of an adverse water quality incident for the drinking water system.

These recommendations are predicated on having a certified operator on site at the drinking water treatment plant 24 hours a day, 7 days a week. A number of recommendations focused on making improvements to the sewage collection system and sewage treatment facility to protect the drinking water source. Analytical results show that the drinking water from the Kashechewan Drinking Water System met all provincial standards for the broad range of parameters that similar municipal systems in Ontario are required to test.

Structure of Report

The report speaks to the Ministry of the Environment's findings based on its on-site assessments of the Drinking Water and Sewage Systems of the Kashechewan First Nation and the results of the water samples.

The technical assessments of the Kashechewan Drinking Water System and of the Kashechewan Sewage Collection and Treatment System are attached as Appendix A and Appendix B. The tables and figures referred to in both assessments are included as Appendix C. The analytical results of the water samples taken during the on-site assessments appear in Appendix D.

A number of documents were provided to assist the Expert Technical Team in conducting the assessments. These are listed in Appendix E.

The Ministry based its assessments on the requirements in Ontario for municipal drinking water systems and sewage systems. A list of the Acts, Regulations, Guidelines, Policies and Procedures that provided the context for the Expert Technical Team when undertaking the technical assessments is provided in Appendix F.

Appendix G identifies the members of the Ministry of the Environment's Expert Technical Team.

Ministry of the Environment's Actions

In late October 2005, the Ontario Ministry of the Environment offered to provide its expertise on drinking water to the federal government and the community of Kashechewan regarding the Kashechewan Drinking Water System.

The engagement of Ontario's water management expertise is part of the province's contribution to the federal government's "Plan to assure the health of residents of Kashechewan and the long-term well being and sustainability of their community".

The Ministry deployed an Expert Technical Team on October 28, 2005, to Kashechewan. The Ministry's Expert Technical Team was led by the Ontario Ministry of the Environment's Chief Drinking Water Inspector and involved two senior engineers and two senior inspectors from the Ministry with expertise in both drinking water and sewage systems.

At the invitation of Chief Friday and the Band Council, the Expert Technical Team conducted assessments of the design and operations at the Kashechewan Drinking Water System and the Sewage Collection System and Sewage Treatment Facility from October 28 - 30, 2005. Staff of the Kashechewan Drinking Water and Sewage Systems provided valuable insights and expertise that contributed to the successful completion of the technical assessments during the on-site visit.

During the assessment period, water samples were collected from a range of locations for subsequent analysis for microbiological, chemical and physical parameters on a priority basis.

The results of the microbiological tests were conveyed to Chief Friday and Indian and Northern Affairs Canada on October 31, 2005. A full reporting of all water quality analysis results is contained in this report (Appendix D).

Assessment Objectives

The primary focus of the Ministry's Expert Technical Team was to complete a technical review of the performance of the Kashechewan Drinking Water System and to offer recommendations that will allow the system to reliably provide potable drinking water.

The design and operation of the sewage collection and treatment systems were primarily assessed in relation to the potential impacts on the drinking water source. Other issues related to the operation of the sewage systems on the drinking water source in general are also discussed in the technical assessment.

Ministry's Approach to Safe Drinking Water

The government of Ontario has developed an eight component safety net consisting of legislative and program initiatives designed to protect Ontario's drinking water from source-to-tap. The MOE Expert Technical Team used this framework, as it applies to similar municipal drinking water systems, as a basis for comparison to the operation and performance of the Kashechewan Drinking Water System.

The components of this safety net are as follows:

- Comprehensive regulatory framework
- Timely, reliable testing
- Immediate notification and corrective action on AWQI
- Licensing, training and certification
- Comprehensive inspection program
- Investigation and enforcement of legislation and regulations
- Integrated data acquisition and information management
- Education and outreach

Further detail on this safety net can be found in the Chief Drinking Water Inspector's Progress Report (May 2005), which can be accessed on the Ministry of the Environment website, www.ene.gov.on.ca.

Key Findings

This section of the report outlines the main findings of the Ministry of the Environment's Expert Technical Team who conducted on-site assessments of the Kashechewan Drinking Water and Sewage Systems.

The first part reports on water quality tests taken from the drinking water treatment and distribution system.

The second part summarizes the technical assessment of the Kashechewan Drinking Water System.

The third part reports on the sewage collection system and sewage treatment facility, specifically as it potentially impacts the source of the community's drinking water.

Part 1: Water Quality Tests

Description of Samples Taken

As part of the assessment, a number of water samples from the Kashechewan drinking water treatment and distribution system were collected on October 29 and 30, 2005. The results of the microbiological analysis were communicated by the Ministry of the Environment to the Kashechewan First Nation and Indian and Northern Affairs Canada on October 31, 2005. Those results indicated no E.coli or total coliform bacteria were present in the samples collected and analyzed.

The following is a list of samples collected, their locations and the analyses conducted:

- distribution system samples collected on October 29, 2005, (seven sample sites) were tested for:
    - microbiological parameters (total coliform, E. coli, general background colonies)

  - turbidity and free chlorine residual (on-site measurement at each location)
  - trihalomethanes and lead (from each of the seven sample sites)

- treated water samples collected on October 30, 2005, (from the treated water clearwells) were tested for:
  - microbiological parameters (total coliform, E. coli, general background colonies)
  - turbidity and free chlorine residual (on-site measurement)
  - all Ontario Regulation 169/03 parameters for which municipal drinking water systems are required to test

- raw water samples collected on October 30, 2005, (discharge from the low lift pump header pipe) were tested for:
  - turbidity (on-site measurement)
  - all Ontario Regulation 169/03 parameters as above (Municipal drinking water systems are not required to test raw water for all of these parameters. These tests were undertaken to provide supplementary information to the Expert Technical Team)

- distribution system samples collected on October 30, 2005, (six sample sites) were tested for:
  - microbiological parameters (total coliform, E. coli, general background colonies)
  - turbidity and free chlorine residual (on-site measurement at each location)
  - trihalomethanes and lead (from each of the six sample sites).

Summary Assessment – Drinking Water Quality Test Results

Analytical results from the samples collected on October 29 and 30 shows that the drinking water from the Kashechewan Drinking Water System met all provincial standards for the broad range of parameters that similar municipal systems in Ontario are required to test. Refer to the tables of analytical results in Appendix D.

Part 2:	Kashechewan Drinking Water System

Description of the Drinking Water System

The Kashechewan First Nation Water Treatment Plant (WTP) provides the community's drinking water. The Red Willow Creek is the surface water source for this facility. This creek flows into the Albany River which ultimately flows into James Bay.

Water from the Red Willow Creek flows through a coarse screen prior to entering the plant's low lift well in the intake facility.

Raw water is then pumped into the treatment facility which consists of a chemically-assisted filtration process and a chlorine disinfection process. Treated water is stored in the plant's clearwell, from which it is pumped into the distribution system.

Summary Assessment - Operations

Physical Works and Treatment Processes

The assessment found that a number of components of the drinking water system were consistent with provincial standards that would be imposed on similar facilities. This includes the observation that there are water flow measuring devices installed to monitor raw water flow (low lift pump flow) into the treatment process units, and treated water flow from the plant into the distribution system (high lift pump flow).

For surface water sources, provincial standards for minimum treatment require the treatment equipment to be:

- capable of chemically assisted filtration
- capable of achieving, at all times, primary disinfection, including at least 2 log (99 %) removal or inactivation of Cryptosporidium oocysts, at least 3 log (99.9 %) removal or inactivation of Giardia cysts and at least 4 log (99.99 %) removal or inactivation of viruses by the time water enters the distribution system

- operated in accordance with the “Procedure for Disinfection of Drinking Water in Ontario”

The water treatment plant serving the Kashechewan First Nation is a conventional treatment system consisting of chemically assisted coagulation, filtration and disinfection by chlorination. The Expert Technical Team concluded that this process would meet provincial standards if it was operated and maintained in accordance with the “Procedure for Disinfection of Drinking Water in Ontario”.

A number of procedures that had been in place in the Kashechewan WTP were determined to be inconsistent with current provincial practice. They are as follows:

- the absence of a documented procedure for the disinfection of drinking water at the WTP
- the use of treatment chemicals that did not meet the chemical quality standards of the American Water Works Association (AWWA) and the American National Standards Institute (ANSI). (Note that as of October 15, 2005, the contracted operating authority, Northern Waterworks Inc. has implemented the use of treatment chemicals that do meet these prescribed standards)
- the installation of an insecure bypass so that raw water could be directed around the clarifier to the filters
- the lack of process instrumentation

Additional concerns identified with the assessment of the physical works included:

- the existence of a number of potential cross-connections between treated and untreated/process wastewater
- the lack of up-to-date drawings for both the water treatment plant and water distribution system on-site at the time of the assessment

The Expert Technical Team found that there were a number of areas that indicated the need for improved maintenance procedures within the drinking water system including:

- inoperative check valve on the supply piping from the low lift pumps
- inoperative chemical metering pumps
- broken and completely obstructed chemical feed lines
- leaking water supply lines in the chemical mixing area
- filters requiring inspection and media exchange

The Expert Technical Team also concluded that regular calibration of instruments was not being performed (e.g., continuous chlorine analyzer operated without being calibrated, flow meters had never been calibrated, etc.).

Summary Assessment - Water System Management Practices

Operations Manuals and Procedures

At the time of the technical assessment of the Kashechewan Drinking Water System, there were no operations manuals for the water treatment plant or distribution system.

Provincial standards require operations manuals so that operations and maintenance staff have up-to-date information and are able to easily access important information such as:

- procedures for monitoring, inspecting and evaluating all equipment such as water pumps and chemical metering equipment used in the treatment process
- procedures for the monitoring and recording of process-control parameters
- guidance for the performance of important treatment process-related activities (e.g. sludge removal from the clarifiers and filter backwashing)

Logbooks

The Expert Technical Team found that previous practice regarding maintenance of logbooks was not consistent with provincial practice. For instance, there did not appear to be any records of treatment chemical usage nor was a logbook being used for the recording of any operations and maintenance activities in the water distribution system.

The team did note that the newly contracted plant operator has started to improve record-keeping procedures.

Contingency and Emergency Planning

At the time of the assessment, there were no contingency and emergency plans for the water treatment plant or distribution system. Provincial standards require these plans in order to ensure that there is adequate equipment and material to deal with emergencies, upsets and equipment breakdown.

However, during the assessment it was noted that the system did meet some of the requirements of provincial standards in this area such as:

- treatment chemical storage tanks and diesel fuel tanks were generally enclosed in spill containments
- newly installed chemical metering equipment was configured to include duty and standby storage tanks and pumps

The team also noted that, since the arrival of the newly contracted operator on October 15, 2005, a limited number of contingency-related procedures have been developed and some training for plant staff has taken place.

Security

The Expert Technical Team concluded on the basis of its assessment that there were no pressing issues regarding facility security. The treatment building is of relatively recent construction with steel siding and appeared to be adequately secure. Access doors are of steel construction and there is area lighting installed on the exterior of the building.

Communication with Consumers

There is no system in place to record the nature, cause and response to consumer complaints. Typically, such a system would be required by provincial standards.

Operator Certification and Training

Provincial standards are based on the principle that trained personnel are an integral element of the system to reliably provide potable drinking water.
The Expert Technical Team found that practice in this area did not meet the provincial standards.

The newly contracted plant operator possesses a valid Class 3 water treatment certification and could be designated as the “Overall Responsible Operator”, meeting the equivalent of the provincial standard. Four of the plant personnel have been certified to the level of “Operator-in-Training” (OIT) as defined by provincial regulations.

Water Quality Monitoring

The Expert Technical Team concluded that the sampling and testing practices at the Kashechewan Drinking Water System did not reflect provincial microbiological and physical/chemical test requirements. However, it was noted that some aspects of water quality monitoring are generally consistent with provincial standards such as:

- samples for chlorine residual analysis were being tested using continuous monitoring equipment
- the existing monitoring equipment was capable of measuring chlorine residuals with the required accuracy

Reporting, Notification and Corrective Actions

In terms of the reporting of adverse test results and subsequent corrective actions, and notice of issue resolution, the team did not find evidence of a clearly defined protocol that is equivalent to the current provincial standards.

Regarding the process equipment at the Kashechewan WTP, it was also observed that there are no alarms connected to the continuous free chlorine analyzer. The Expert Technical Team noted that there was no process in place to provide information about the performance of the drinking water system to the users of the system.

Part 3:	Kashechewan Sewage Collection and Treatment System

Description of Potential Threat to Source Water

The Expert Technical Team ascertained through discussion with plant personnel that little emphasis had been placed on source protection due to the remote location of this community. The sewage collection system and the sewage treatment facility were the only apparent threats to source water quality. There were no identified industrial or agricultural activities being undertaken within the watershed of the Albany River and Red Willow Creek. Accordingly, the Expert Technical Team conducted an assessment of the sewage collection system and the sewage treatment facility.

Summary Assessment – Sewage Collection System

The Kashechewan First Nation sewage collection system is composed of three sewage lift stations, forcemains and gravity sewers. Sewage is conveyed to the sewage treatment facility through a series of three lift stations. Overflow from the sewage collection system is discharged to the Albany River via the overflow sewer.

Based on the observations made during the on-site assessment, the Expert Technical Team identified a number of areas of concern.

- Two of the three sewage lift stations were non-operational. This potentially reduces storage capacity within the sewage collection system. Under these conditions, if the other sewage lift station fails, the potential of an overflow of sewage to the Albany River may increase.

- The overflow sewer and associated backflow prevention device were broken. This could permit water to enter the sewage collection system, resulting in flooding of the community during high water levels in the Albany River.

- The overflow sewer is located adjacent to the shoreline of the Albany River, upstream of the surface drinking water supply intake within the Red Willow Creek. Tidal influences experienced in the area could potentially transport

contamination along the shoreline of the Albany River and near the drinking water intake.

- There is no dedicated standby power supply for the sewage collection facility. This increases the potential for raw sewage to overflow to the Albany River during an extended power supply outage.

Summary Assessment – Sewage Treatment Facility

The sewage treatment facility is located immediately north-east of the community, on the north-east side of Red Willow Creek (Figure 2). The facility consists of two individual waste stabilization ponds (i.e. lagoons), cell 1 and cell 2. Cell 1, constructed in about 1988, is reported to have a working capacity of 83,200 m^3. As determined from a review of available engineering reports, the working capacity of cell 2, constructed in about 1999/2000, is 104,000 m^3. The lagoon cells were designed to discharge on a seasonal 7-day discharge basis, including one discharge period in the spring and one in the fall of each year.

Raw sewage is pumped by lift station 1 (LS-1) into the distribution chamber located on the south side of the lagoons. Sewage is then discharged into a bermed area within the south-west corner of cell 1 or the north-west corner of cell 2. Following retention in the cells, the clarified effluent is discharged from either cell through the discharge chamber located at the north-east corner of cell 1. Treated effluent from the discharge chamber enters a ditch that leads to East Creek. East Creek flows in a north-easterly direction for a distance of approximately 8 km from the sewage lagoons towards James Bay (Figure 6).

The Expert Technical Team compared the main design features of the Kashechewan First Nation sewage lagoons with the provincial design guidelines. The comparison revealed that the Kashechewan sewage lagoons, for the most part, meet provincial design guidelines.

The Expert Technical team also conducted an assessment of the operation of the sewage treatment facility and identified the following main issues of concern:

- The sewage treatment system is not being operated and maintained in accordance with its original operational design. This presents a risk for environmental impairment.

- The presence of obstructions within East Creek presents a risk that discharged effluent will back up into Red Willow Creek, upstream of the surface drinking water supply intake for the community of Kashechewan First Nation.

- There is a lack of contingency planning and operator training. These are both important to ensure that the system is operated properly and should problems arise, operators are knowledgeable enough to respond.

- There appears to be a lack of monitoring conducted in relation to the discharged effluent and potential receivers of the discharge effluent (i.e. East Creek and Red Willow Creek). In addition, there also appears to be no formalized reporting mechanism. This raises the concern that should problems occur, they may go unnoticed.

Summary Assessment - Water Quality Test Results

A basic sampling program was conducted as part of the assessment. Samples were obtained from surfaces waters within the immediate area and from the sewage treatment facility. There was no indication of an abnormal concentration of any water quality parameter.

Summary of Recommendations

The Expert Technical Team recommended a number of actions to safeguard Kashechewan's drinking water.

The recommendations are organized by system:

- Kashechewan Drinking Water System
    - Operations
    - Management Practices

- Kashechewan Sewage System
    - Sewage Collection System
    - Sewage Treatment Facility

They are also organized along three timelines:

- immediate
- medium-term (within 1 year)
- long-term (within 2 years)

While the results of the drinking water tests verify that the drinking water was potable during the period of the on-site visit, the Expert Technical Team determined that a number of immediate measures need to be taken so that the Kashechewan Drinking Water System can reliably provide potable drinking water on an ongoing basis.

A number of recommendations should be implemented in the medium-term (within 1 year) or long-term (within 2 years). In all cases, these medium and long-term timelines are predicated on having a certified Class II (minimum) operator on-site 24 hours a day, 7 days a week, effective immediately.

KASHECHEWAN DRINKING WATER SYSTEM - OPERATIONS

RECOMMENDATIONS: PHYSICAL WORKS AND TREATMENT PROCESSES

Immediate

- Use approved (AWWA/ANSI) treatment chemicals only.
- To ensure the system is able to continuously meet treated water disinfection standards:
    - install continuous monitoring chlorine analyzer with high and low level alarm
    - install a treated water flow meter

Medium-term (within 1 year)

- To ensure that the plant meets appropriate turbidity standards (i.e. 0.5 NTU 95% of the time), must:
    - upgrade chemical storage and metering system with automation;
    - undertake inspection and replacement of filter media
    - repair/replace backwash air scour system
    - provide Programmable Logic Controller (PLC) to flow pace chemicals (coagulant, polymer and sodium hypochlorite)
- To effectively monitor filter performance:
    - provide continuous monitoring turbidity analyzer on each with a high turbidity alarm
    - provide Programmable Logic Controller (PLC) to operate filter backwash cycle with filter-to-waste procedure
- To further ensure the system is able to continuously meet treated water disinfection standards:
    - provide baffling in chlorine contact tank (clearwell) and relocate inlet/outlet pipes to enhance primary disinfection. This will help to ensure that the chlorine residual can be better controlled, especially in the winter months
    - upgrade chlorine solution storage and delivery system with automation for the primary disinfection system
    - install an additional post/trim chlorine injection system with automation
- To ensure protection from in-facility contamination:
    - eliminate points of possible cross-connection within the water treatment plant
    - adequately secure the clarifier by-pass so that it cannot be inadvertently opened

RECOMMENDATIONS: INSTRUMENTATION

Immediate
- Calibrate existing equipment.

Long-term (within 2 years)
- Establish a comprehensive procedure for the regular maintenance/calibration of all analyzers and flow meters. As a minimum, follow manufacturers' guidelines.

KASHECHEWAN DRINKING WATER SYSTEM – MANAGEMENT PRACTICES

RECOMMENDATION: OPERATIONS MANUALS

Long-term (within 2 years)

- Create and maintain a comprehensive operations manual that integrates requirements for new equipment as it is commissioned.

RECOMMENDATION: LOGBOOKS

Immediate

- Create and maintain comprehensive logbooks that reflect requirements of current provincial standards to record information related to operation and maintenance of equipment.

RECOMMENDATIONS: CONTINGENCY AND EMERGENCY PLANNING

Immediate

- Establish plans and adequate procedures for the provision of materials and equipment to deal with emergencies, upsets, and equipment breakdowns.

Medium-term (within 1 year)

- Ensure there is a dedicated standby power generator set.
- Ensure sufficient inventory of spare parts is maintained on-site and consider the installation of a second process train (back-up).

RECOMMENDATION: COMMUNICATION WITH CONSUMERS

Medium-term (within 1 year)

- Establish a procedure for the recording and resolution of complaints made by users of the system.

RECOMMENDATIONS: OPERATOR CERTIFICATION AND TRAINING

Immediate

- Conduct an assessment of current knowledge base of staff and assess specific training needs.
- Maintain a certified class II (minimum) operator on-site 24 hours a day, 7 days a week.

Long-term (within 2 years)

- Establish training policy that includes opportunities for ongoing learning.
- Provide SCADA control with the capability for remote monitoring and operation.

RECOMMENDATION: WATER QUALITY MONITORING

Immediate

- Establish a comprehensive sample plan based on current provincial standards for the drinking water system that ensures samples are collected and analyzed regularly at an accredited laboratory.

RECOMMENDATIONS: REPORTING, NOTIFICATION AND CORRECTIVE ACTIONS

Immediate

- Establish protocols for adverse water quality incidents to ensure that appropriate corrective actions are taken. This would require defining adverse incidents, how reporting and notification will happen, what corrective action is appropriate, and how the incident will be considered resolved.
- Establish operator log and in-plant data recording to allow past performance to be assessed, and trends to be identified.

Medium-term (within 1 year)

- Once alarms are installed, establish a protocol for receiving/responding to alarms at the local level (call-out system).

Long-term (within 2 years)

- Consider options for communication of system performance to the community and implement the selected strategy.

KASHECHEWAN SEWAGE SYSTEM

RECOMMENDATIONS: SEWAGE COLLECTION SYSTEM

Immediate

- Repair/replace pumps in lift stations 2 and 3, maintain a spare parts inventory including at least one spare pump at all times, and perform other necessary maintenance to make lift stations functional.
- Repair/replace automatic shut-off device for lift station 1 to prevent the pumps from operating continuously when not required.
- Install alarms which are monitored in a staffed location (e.g. at the water treatment plant) that self-activate under abnormal conditions (e.g. pump failure, high water level) so that appropriate action can be taken as required.
- As an interim strategy, any raw sewage overflow into the Albany River should be responded to by ensuring immediate notification to water treatment plant staff.
- Repair/replace the overflow sewer and backflow prevention device because backflow potential exists.

Medium-term (within 1 year)

- Develop and implement a contingency plan to address potential contamination of the drinking water supply during overflow occurrences (e.g. procedures for notification and response to alarms, an evaluation of potential disinfection of the overflow, and installation and maintenance of a standby power supply).

Long-term (within 2 years)

- Develop and implement an Operations Manual, Preventative Maintenance Program, and Operator Training Program.
- Assess potential of alternate overflow location and configuration.

RECOMMENDATIONS: SEWAGE TREATMENT FACILITY

Immediate

- Re-establish and ensure flow in East Creek by removing any obstructions (e.g. beaver dams).
- Prior to impending (November 2005) cell 2 discharge, redirect raw sewage input to cell 1. Discharge cell 2 over a period of 7 days. Once discharge is complete, redirect raw sewage back to cell 2 and cease continuous discharge from cell 1.

Medium-term (within 1 year)

- Assess alternatives to reduce possibility of East Creek flow into Red Willow Creek, (e.g. install barrier in southern terminus of East Creek).
- Operate and maintain the sewage treatment facility in accordance with the Operations Manual (e.g. seasonal, 7-day discharge schedule, pre-discharge survey of East Creek).
- Develop and implement a contingency plan to be used in the event of backflow of lagoon effluent into Red Willow Creek (e.g. procedures for notification and evaluation of potential disinfection of the lagoon discharge).
- Assess and repair the breach and overflow pipe within the berm separating the two cells.

Long-term (within 2 years)

- Consider an alternate discharge strategy to reduce the risk of flow into Red Willow Creek (e.g. alternate receiver of lagoon discharge).
- Review the Operations Manual and update regularly (e.g. directions for regular inspections of the facility by operators, retention of appropriate monitoring records, and formalization of reporting mechanism).
- Develop and implement an Operator Training Program.
- Develop and implement a Preventative Maintenance Program.
- Develop and implement a sampling and monitoring program for the lagoon cells, lagoon effluent, East Creek and Red Willow Creek. It is recommended that flow measuring be undertaken as part of this monitoring program.

GLOSSARY

AWWA/ANSI	American Water Works Association/American National Standards Institute
Chemically-assisted filtration	Process used in a drinking water system in which chemicals are added to raw water so that it can be filtered prior to disinfection
Chlorine residual	The chlorine level in water immediately after it has been treated
Class II Operator	Person who has been certified to perform operational checks on a Class II Municipal Drinking Water System as per the requirements of the *Safe Drinking Water Act, 2002*
Clearwell	Reservoir for the storage of filtered water. May also be used to provide chlorine contact time for disinfection
Disinfection	Inactivation of pathogens from filtered water
Drinking water system	System of works, excluding plumbing, that is established for the purpose of providing drinking water. This includes both the water treatment plan (WTP) and the distribution system
Effluent	Water or other liquid that flows from one place to another
Lagoon	Shallow treatment pond where sunlight, bacterial action, and oxygen work to purify wastewater
Pathogen	Disease-causing organism
Potable water (potability)	Water that is safe for human consumption

Programmable Logic Controller	Small computer used to automate processes, such as those used to clarify and disinfect drinking water
SCADA (Supervisory Control and Data Acquisition) system	System that can be used to monitor and control activities and processes at a drinking water system from an off-site location
Sewage Collection System	Facility designed to collect and convey sewage from a community to a sewage treatment facility.
Sewage Treatment Plant	Facility designed to treat sewage by removing materials that may damage water quality and threaten public health.
Turbidity	Cloudy condition in water due to suspended silt or organic matter
NTU (used in describing turbidity standard)	Nephalometric turbidity unit – the standard unit of measurement of turbidity in water

APPENDIX A:

Technical Assessment of the Kashechewan Drinking Water System

ASSESSMENT OF THE DRINKING WATER FACILITIES AT THE KASHECHEWAN FIRST NATION RESERVE

November 10, 2005

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1.0 INTRODUCTION

On October 28, 2005, Ministry of the Environment (Ministry) staff initiated an assessment of the water treatment and distribution systems serving the Kashechewan First Nation. This community is located on the north bank of the Albany River within the Hudson Bay Lowlands, approximately 10 kilometres upstream of James Bay (Figure 1) and 450 kilometres north of Timmins, Ontario. The community is located within the territorial District of Kenora.

The Kashechewan First Nation Water Treatment Plant (WTP) provides treated drinking water to the community. The raw water source is the Red Willow Creek. This creek flows into the Albany River, which ultimately flows into James Bay. The raw water intake for the plant is a 200-mm diameter pipe that extends approximately 90 m into the creek. The intake crib (i.e. the end of the pipe) is located just upstream of the confluence of Red Willow Creek and the Albany River. The area experiences tidal influences, causing a regular reversal in flow within both the Albany River and Red Willow Creek. Two sources of potential contamination of the drinking water supply were evaluated during this assessment – the sewage collection system and the sewage treatment facility.

This assessment was completed on October 30, 2005. It was conducted in the presence of operators for the water treatment and distribution systems. Their time afforded to this assessment, and that of other Kashechewan First Nation members, was greatly appreciated.

1.1 Assessment Objectives

The primary focus of this assessment was to provide a technical review of the Kashechewan Drinking Water System relative to Ontario's standards for a comparable municipal system:

1. Evaluate the ability of the drinking water system to reliably produce potable water
2. Evaluate the water treatment process relative to Ontario Regulation 170/03
3. Evaluate the water treatment controls and instrumentation relative to Ontario Regulation 170/03
4. Evaluate the water treatment plant monitoring and reporting relative to Ontario Regulation 170/03
5. Identify risks to the performance of the drinking-water system
6. Evaluate reliability and redundancy to critical process unit/equipment

Additionally, this assessment includes a review of operating practices in relation to, but not limited to, the following documents:

1. *Safe Drinking Water Act, 2002*
2. Drinking-Water Systems Regulation (Ontario Regulation 170/03)
3. Operator Certification Regulation (Certification of Drinking-Water System - Operators and Water Quality Analysts - Ontario Regulation 128/04)

4. Recommended Standards for Water Works (Ten States Standards)

The Ministry has implemented a rigorous and comprehensive approach in the inspection of water systems that focuses on the source, treatment, and distribution components, as well as water system management practices.

Staff from the Ministry's Safe Drinking Water Branch were accompanied during the assessment by the plant operator from Northern Waterworks Inc. and staff from the Kashechewan Drinking Water System. The Kashechewan First Nation is the Owner and Northern Waterworks Inc. is the newly contracted operating authority for the Kashechewan Drinking Water System, since October 15, 2005.

The drinking water assessment included a physical examination of the treatment plant and distribution facilities, and a review of all relevant documents. Samples from the raw water, treated water and distribution system were obtained for analyses. As well, field measurements for free chlorine residual and turbidity were obtained from the drinking-water system at the time of the sample collection. Plant operations staff was interviewed to determine their overall perception of how the plant was equipped and was being operated.

2.0 EXISTING WATER SYSTEM DESCRIPTION

2.1 Raw Water Source

The Kashechewan First Nation Water Treatment Plant is a surface water treatment plant whose raw water source is the Red Willow Creek. The creek feeds into the Albany River, which ultimately flows into James Bay.

The raw water intake for the plant is a 200 mm diameter pipe that extends approximately 90 m into the creek. The intake crib (end of pipe) is located in the vicinity of where the creek feeds into the Albany River at a depth of 4.5 m. Staff of Public Works Canada has witnessed a reversal of water flow in the Albany River due to the tides in James Bay. This phenomenon could influence the raw water quality at the intake. Refer to figure 2 for further details.

2.2 Water Treatment Plant and Processes

The water treatment plant is located at the mouth of Red Willow Creek. It is a conventional treatment plant with chemically assisted filtration and disinfection processes and is capable of producing approximately 1,390 cubic metres of treated water on a daily basis. Figure 3 is a process flow diagram of the major components of the plant.

2.2.1 Intake Works

Water from the Red Willow Creek flows through the intake and into a raw water intake well located on shore. From there, the raw water passes through a coarse screen to remove large debris or fish entering into the plant's low lift well. The design of the water treatment plant intake in the creek is such that impact from possible ice jams in the river is minimized.

The location of the water treatment plant intake in Red Willow Creek is such that potential contamination from overflow of raw sewage from the sewage collection system into the Albany River is minimized, and impact from the sewage lagoon discharge which is designed to flow towards James Bay via East Creek, is reduced.

2.2.2 Low Lift Well

From the low lift well, the water is pumped via two (2) low lift pumps to the clarification treatment process in the plant. Coagulant chemical is added in the low lift well pump discharge pipe to aid in the settling of particulate matter in the raw water.

2.2.3 Clarification

Water is pumped from the low lift well to the plant's single clarifier. A temporary polymer feed system is set up on the clarifier. Within the clarifier, the larger, heavier, particulate matter is allowed to settle to the bottom. The clarified effluent then flows into the plant's filtration system. Sludge at the bottom of the clarifier is discharged to the sanitary sewer.

2.2.4 Filtration

The filtration system at the plant consists of two (2) sand and anthracite media gravity filters. Water from the clarifier enters into a splitter box and proportionate water enters into each filter by gravity. The filters have a backwashing system to routinely remove particles trapped in the media. Filter backwash cycle is initiated manually by the operator. The wastewater produced by backwashing the filters is directly discharged to the sanitary sewer.

2.2.5 Clearwell/Chlorine Contact Tank

The filtered water is chlorinated and flows into the plant's clearwell. The clearwell is comprised of two (2) separate cells, each with a volume of approximately 278 cubic metres. The clearwell serves two purposes: first, it provides contact time for the chlorine to disinfect the water, and second it provides treated water storage for the distribution system.

2.2.6 High Lift Pumping

Treated water from the clearwell is pumped into the distribution system via five (5) high lift pumps. There is also one (1) fire pump for emergency services.

2.2.7 Chemical Feed Equipment

Chemical feed systems at the plant currently consist of coagulant and polymer feed systems to aid in the settling of particulate matter (within the clarifier) and a sodium hypochlorite feed system for chlorine disinfection. Each of these systems is made up of a single feed pump and chemical storage tank.

2.2.8 Instrumentation and Laboratory Services

The plant has flow measuring devices on the raw and treated water supply mains. The other online instrumentation at the plant is a treated water chlorine residual analyzer and a raw water pH meter.

Minimal laboratory equipment, including equipment used to measure water quality parameters such as turbidity and chlorine, exists at the plant.

2.2.9 Standby Power

There is no emergency standby power generator at the WTP.

2.3 Distribution System

Information from the drawings indicates that the community is serviced by 200 mm and 150 mm diameter PVC constructed water mains, equipped with fire hydrants and isolation valves. The physical condition of the water mains is not known. Additionally, based on the drawings, there appear to be approximately 225 service connections within the distribution system.

3.0 ASSESSMENT FINDINGS

3.1 Operations

3.1.1 Source and Supply

During a discussion with plant personnel, the indication was that there is no consideration given to source protection due to the remote location of this community. Additionally, it is unlikely that there are any industrial and agricultural activities being undertaken on the Albany River and Red Willow Creek.

The sewage collection system and sewage lagoon were the only apparent point source threats that may impact the surface water quality. Refer to Figure 4 for further details.

3.1.2 Capacity Assessment

Observations made during the physical inspection of the WTP indicated that there are water flow measuring devices installed to monitor raw water flow (low lift pump flow) into the treatment process units, and treated water flow from the plant into the distribution system (high lift pump flow). This would be considered to be in line with facilities requiring a Certificate of Approval under the *Safe Drinking Water Act, 2002*.

The flow meter on the treated water supply piping has been inoperable for an undetermined amount of time. Plant personnel could not provide details of this instrument ever being functional or regularly calibrated.

The flow meter on the raw water supply piping had been operational until mid-April 2005, at which time an undetermined malfunction occurred. Plant personnel could not recall this meter ever being calibrated. Generally speaking, a Certificate of Approval under the *Safe Drinking Water Act, 2002* would specify that certain flow measuring devices are to be maintained in an operating condition and are to be calibrated at regular intervals that do not extend longer than one year.

The capacity of the treatment system was determined to be 1,390 cubic metres per day.

Records from the water treatment plant's raw flow measuring device indicated that for the period December 1, 2004 to April 21, 2005, the maximum flow was 974.0 cubic metres per day. For a facility that operates according to a Certificate of Approval under the *Safe Drinking Water Act, 2002*, the maximum flow into the treatment system should not exceed the system's rated capacity.

The average daily flow was approximately 630 cubic metres per day for that same period.

3.1.3 Treatment Processes

The existing water treatment process was assessed to determine whether it would meet the minimum treatment requirements for surface water source as required by Ontario Regulation 170/03 and the "Procedure for Disinfection of Drinking Water in Ontario". For surface water sources, provincial standards in O.Reg.170/03 for minimum treatment require the treatment equipment to be:

a) designed to be capable of chemically assisted filtration, and
b) capable of achieving, at all times, primary disinfection, including at least 2 log (99 %) removal or inactivation of Cryptosporidium oocysts, at least 3 log (99.9 %) removal or inactivation of Giardia cysts and at least 4 log (99.99 %) removal or inactivation of viruses by the time water enters the distribution system.
c) operated in accordance with the "Procedure for Disinfection of Drinking Water in Ontario".

The water treatment plant serving the Kashechewan First Nation is a conventional filtration system consisting of chemically assisted coagulation, filtration and disinfection by chlorination. This water treatment process would meet the Ministry's requirement (Ontario Regulation 170/03) if operated as conventional filtration in accordance with the "Procedure for Disinfection of Drinking Water in Ontario".

Effective operations typically require:

- Use of chemical all the times when the treatment process is in operation;
- Monitoring and adjustment of chemical dosage in response to variation in raw water quality;
- Maintenance of effective backwash procedures, including filter-to-waste, to ensure that the effective turbidity requirements are met at all times;
- Continuous monitoring of filtrate turbidity from each filter; and
- Meeting the performance criterion for filtered water turbidity of less than or equal to 0.5 NTU in 95 % of the measurements each month;
- Primary disinfection by free chlorination (CT and monitoring) in accordance with the "Procedure for Disinfection of Drinking Water in Ontario".
- Secondary disinfection maintenance of free chlorine residual in the distribution system samples.

It was determined that there was no documented procedure for the disinfection of drinking water at the WTP and that the local operators could not fully explain the disinfection procedure that was used. However, the contracted operator from Northern Waterworks Inc. did have knowledge of the Ministry's "Procedure for Disinfection of Drinking-Water in Ontario".

Treatment chemicals previously used at the water treatment plant did not meet the chemical quality standards of the American Water Works Association (AWWA) and the American National Standards Institute (ANSI). As of October 15, 2005, Northern Waterworks Inc. has implemented the use of treatment chemicals that do meet these prescribed standards.

During the physical assessment of the treatment process works, a clarifier bypass was found to be installed so that raw water could be directed around the clarifier to the filters. This would facilitate maintenance of the clarifier without shutting the WTP. Water treatment plants that operate with a Certificate of Approval under the Safe Drinking Water Act are typically directed to remove or secure all such process bypass piping.

A number of potential cross-connections between treated and untreated/process waste water were also observed. It is understood that Northern Waterworks Inc. has provided a proposal to eliminate or secure the plant by-pass and all potential cross-connections.

Up-to-date drawings for both the water treatment plant and water distribution system have not been made available for use by plant personnel for an undetermined amount of time. During the physical assessment, sets of drawings were provided by a representative of Public Works and Government Services Canada. A set of these drawings have been provided to the plant operators for future reference.

Provisions of the *Safe Drinking Water Act, 2002* require that a drinking water system be maintained in a fit state of repair. The following are observations that were made during the physical assessment of the Kashechewan Drinking Water System that indicate a need for improved maintenance procedures:

- Inoperable raw and treated water flow measuring devices
- Inoperative check valve on the supply piping from the low lift pumps
- A number of burnt out area lights in the low lift pump area
- Inconsistent operational ability of the variable speed drive units for the low lift pumps
- Inoperative chemical metering pumps
- Broken and completely obstructed chemical feed lines
- Continuous chlorine analyzer periodically inoperative or operated without being calibrated
- Leaking water supply lines in the chemical mixing area
- Lack of disposal of discontinued treatment chemicals
- Filters requiring inspection and media exchange
- Inoperable clearwell level indicators

Ontario Regulation 170/03 requires that for a water treatment facility such as this, coagulant chemicals are to be fed into the treatment process on an ongoing basis whenever water is being treated. Observations made during this physical assessment indicated that there were occasions where coagulant chemicals were not being fed into the treatment system of the Kashechewan WTP.

It was confirmed that pesticides are not applied, stored, or mixed in the immediate vicinity of the water treatment plant's intakes.

Ontario Regulation 128/04 requires that a procedure be established for the monitoring, inspection, testing and evaluation of process related equipment. Northern Waterworks Inc. has recently instituted a new procedure that specifically addresses this issue. Previous to this, there were no such procedures in place at the Kashechewan WTP to ensure the efficient and reliable functioning of critical process equipment.

3.1.4 Process Wastewater

Process wastes are generated at the Kashechewan WTP in the form of clarifier sediments and filter backwash solids. It was confirmed during the physical assessment that the process wastewater stream cannot be recycled back into the treatment process.

As the process wastewater is discharged to the sanitary sewage system, a typical Certificate of Approval under the *Safe Drinking Water Act, 2002* would not impose conditions that are related to compliance with process wastewater monitoring and discharge quality guidelines.

Additional observations made relative to the process wastewater include the following:

- Solids are regularly withdrawn to maintain a uniform sludge blanket in the clarifier.
- There were no reports of adverse surface water quality as a result of the discharge of backwash wastewater.
- There did not appear to be obvious environmental impact as a result of discharged wastewater to the sanitary sewage system.

3.1.5 Distribution System

It was confirmed that maintenance and repairs to the distribution system are made by personnel who had attained the Operator-in-Training designation as defined by Ontario Regulation 128/04. Additionally, it was indicated that personnel not having operator certification also performed repair and maintenance activities.

Ontario Regulation 128/04 also requires that a maintenance and repair record keeping system be used for the distribution system. It was confirmed during the assessment of this system that there were no such records of any previous maintenance or repairs. As of October 15, 2005, Northern Waterworks Inc. has provided instruction to the local system

personnel to record all such distribution system activities in a master log book at the WTP.

Additional observations made relative to the water distribution system during the assessment include the following:

- Up-to-date plans of the system were not available to personnel
- There are no known cross-connections within the distribution system to other water sources such as wells and cisterns
- There has been a recommendation by Northern Waterworks Inc. that there no longer be cross-connections and that backflow prevention devices be used
- Fire hydrants are used to flush the system at least annually
- Water is removed from hydrants to maintain "dry barrels" and a non-toxic anti-freeze is applied to each hydrant in the fall
- Hydrants are typically repaired by outside contractors and there are several fire hydrants that do not operate properly
- System main valves are located and exercised on an annual basis
- A disinfection procedure is not being used when performing repairs to components of the system. Northern Waterworks Inc. indicated that they could develop this procedure as part of the proposed training that will be provided to the local personnel.
- The system piping is less that 15 years old and there currently is no program existing to address routine replacement of water mains.
- There is nothing in place to restrict the access of unauthorized persons to fire hydrants.
- There have never been instances where private pesticide applicators have used hydrants during the mixing of pesticides.
- Unusual water output from the plant and reports from the public serve as the only form of leak detection for the distribution system.
- Pressure readings are never measured from points within the distribution system.
- The water pressure at the point of entry into the distribution system is currently 40 psi, and there have been instances of complaints of low water pressure made by users of the system.

3.1.6 Recommendations - Operations

The Table below summarizes key recommended upgrades for the water treatment plant:

Physical works and Treatment Processes
Immediate

- Use approved (AWWA/ANSI) treatment chemicals only
- To ensure the system is able to continuously meet treated water disinfection standards:
  - install continuous monitoring chlorine analyzer with high and low level alarm

    - install a treated water flow meter

Medium-term (within 1 year)

- To ensure that the plant meets appropriate turbidity standards (i.e. 0.5 NTU 95% of the time), must:
    - upgrade chemical storage and metering system with automation;
    - undertake inspection and replacement of filter media
    - repair/replace backwash air scour system
    - provide Programmable Logic Controller (PLC) to flow pace chemicals (coagulant, polymer and sodium hypochlorite).
- In order to effectively monitor filter performance:
    - provide continuous monitoring turbidity analyzer on each filter with a high turbidity alarm
    - provide Programmable Logic Controller (PLC) to operate filter backwash cycle with filter-to-waste procedure.
- To further ensure the system is able to continuously meet treated water disinfection standards:
    - provide baffling in chlorine contact tank (clearwell) and relocate inlet/outlet pipes to enhance primary disinfection. This will help to ensure that the chlorine residual can be better controlled, especially in the winter months
    - upgrade chlorine solution storage and delivery system with automation for the primary disinfection system
    - install an additional post/trim chlorine injection system with automation.
- To ensure protection from in-facility contamination:
    - eliminate points of possible cross-connection within the water treatment plant
    - adequately secure the clarifier by-pass so that it cannot be inadvertently opened.

Instrumentation
Immediate

- Calibrate existing equipment.

Long-term (within 2 years)

- Establish a comprehensive procedure for the regular maintenance/calibration of all the analyzers and flow meters. As a minimum, follow manufacturers' guidelines.

3.2 Water System Management Practices

3.2.1 Operational Manuals

At the time of the physical assessment of the Kashechewan Drinking Water System, Operations Manuals had not been created and made available for both the water treatment plant or distribution system.

Ontario Regulation 128/04 requires that operations manuals are created and made available to operations and maintenance staff. Additionally, operations manuals should contain the following elements:

- Plans, drawings and process descriptions that are kept up-to-date.
- Procedures to ensure that all equipment such as water pumps and chemical metering equipment used in the treatment process is monitored, inspected and evaluated. This would include monitoring equipment such as chlorine residual analyzers.
- Procedures for the monitoring and recording of process-control parameters.
- A sampling plan that includes provisions for varying the schedule such that sampling is not only done during optimal conditions.
- Guidance for performing important treatment process related activities such as sludge removal from the clarifiers and filter backwashing.
- Identification, notification and corrective action procedures for adverse conditions such as low and high chlorine residual concentration, and harmful bacteria and viruses in the drinking water.
- Procedures for the disinfection and repair of watermains, and the documentation of these repairs.
- Contingency plans and procedures for the provision of adequate equipment and material to deal with emergencies, upsets and equipment breakdown.

3.2.2 Logbooks

Information reviewed during the physical assessment of the Kashechewan Water Treatment Plant indicated that the plant staff has been using a single log sheet entitled "DAILY WATER QUALITY AND PRODUCTION LOG SHEET – WATER TREATMENT PLANT".

In general, data related to water use, in-plant process parameters and free chlorine residuals are recorded on a daily basis. In addition, operators included comments related to the identity of the staff at the plant at a particular time, backwashing and de-sludging activities, and lack of chemical availability.

There did not appear to be any records of treatment chemical usage.

As indicated during a discussion with plant staff, a logbook is not used for the recording of any operations and maintenance activities in the water distribution system.

Ontario Regulation 128/04 requires that operations manuals be created and made available to operations and maintenance staff. Additionally, log books should contain the following elements:

- Logbooks are used to record information related to the operation and maintenance for both the water treatment plant and water distribution system.
- Logbook entries are made in chronological order

- Logbook entries are only made by an Operator-In-Charge or authorized personnel
- All people making entries into the logbooks should clearly include their name with the comments
- A listing of names of people doing work in the plant and distribution system
- For every required operational test and for every required sample, a record of the date, time, location, name of the person and result of the test
- Documentation and details of departures from normal operating procedures along with the time they occurred
- Recording of unusual/abnormal conditions observed at the facility along with action taken
- Recording of equipment maintenance/break-downs and actions taken during repairs
- Identification of special instructions given to depart from normal operating conditions and the name of the person giving those instructions
- Details of any equipment that was taken out of service or ceased to operate during a shift and the work done to maintain or repair that equipment
- The Operator-in-Charge is required to ensure that records are maintained of all adjustments made to the processes within their responsibility
- The saving of all logbooks for five years from the date of the last entry

It should be noted that Northern Waterworks Inc. had initiated the use of logbooks that appeared to include many of these elements. Some initial training of the local plant staff on the use of the logbooks had been undertaken.

3.3.3 Contingency and Emergency Planning

At the time of the physical assessment of the Kashechewan Drinking Water System, a Contingency and Emergency Plan had not been created and made available for both the water treatment plant or distribution system. As required by a typical Certificate of Approval issued under the *Safe Drinking Water Act, 2002*, contingency and emergency plans must be created to provide adequate equipment and material to deal with emergencies, upset and equipment breakdown.

Contingency and emergency plans should include the following elements:

- Procedure for operating the facility when key operating staff is absent or unable to act for an extended period.
- Procedure to identify the availability of key equipment and spare parts required in the event of an emergency or upset conditions such as pump breakdowns and water main breaks.
- Procedure to ensure the availability of an adequate inventory of extra water treatment chemicals
- Procedure for periodic training and testing of the contingency and emergency plans.

- Procedures to acquire maintain and use clean-up equipment and materials on-site for the clean-up of spills of treatment chemicals and diesel fuel.
- Scenario specific responses to the various emergency and upset conditions that have a significant probability of occurring in the plant and distribution system.
- Provide for the availability of a standby generator at the water treatment plant. In order to maintain adequate pressure in the water distribution system, it is essential to equip the plant with a standby power generator. This ensures maintenance of the treatment process and operation of the high lift pumps and will avoid possible negative pressure in the distribution system.

Observations made during the physical inspection of the water treatment plant confirmed the following:

- Treatment chemical storage tanks and diesel fuel tanks were generally enclosed in spill containments.
- Newly installed chemical metering equipment was configured to include duty and standby storage tanks and pumps

It should be mentioned that since the on-site arrival of Northern Waterworks Inc. on October 15, 2005, a limited number of contingency-related procedures have been developed. Local plant staff has also received some training on those procedures.

3.3.4 Security

During the physical assessment of the water treatment plant, the following observations were made related to facility security:

- The treatment building is of relatively recent construction with steel siding and appears to adequately secure. Access doors are of steel construction and there is area lighting installed on exterior of the building.
- The water treatment plant is generally visited at least once per day by local staff.
- Doors are kept locked when staff are absent from the plant, however it was not determined who had possession of keys.
- Man-way hatches to the treated water clearwells are kept closed; however they are not sealed to prevent the entrance of fluids.
- There are no signs indicating restricted access and no trespassing.
- There was no security fencing surrounding the water treatment plant.

In general terms, appropriate security measures should be in place that includes: signage that reflects access restrictions, lockable and sealed manway hatches, and facility-surround chain-link fencing with lockable access gates.

3.3.5 Communication with Consumers

Currently there is no system in place that records the nature and possible cause of consumer complaints and the corrective measures taken to alleviate the cause and prevent its reoccurrence. Drinking water system staff does respond to consumer complaints but do not maintain any records of the complaint or the actions taken to resolve it.

Inquiries related to documents and information pertaining to the water treatment plant and distribution system could be addressed through the Band Council.

Typically, written reports related to water plant performance have never been created

3.3.6 Operator Certification and Training

Relating to facility and operator training and certification, owners of municipal drinking water systems are required to comply with the "Certification of Drinking-Water System Operators and Water Quality Analysts" regulation, Ontario Regulation 128/04 made under the *Safe Drinking Water Act, 2002*. Observations made during the physical assessment of the WTP indicated that the practice at the plant reflects the following elements:

- In terms of the designation of an "Overall Responsible Operator", a staff member of Northern Waterworks Inc. has been contracted to assume that role as of October 15, 2005.
- Personnel at the water treatment plant are now under the supervision of a person having the prescribed qualifications. The operator from Northern Waterworks Inc. possesses a valid Class 3 water treatment operator certificate
- Four of the plant personnel have been certified as "operator-in-training" as defined by Ontario Regulation 128/04. These certifications expired September 30, 2005
- Operators' certificates are displayed in the location where the facility is being managed
- The facility had applied for and received a "water treatment class II" facility classification certificate, although this is not a regulatory requirement for a system of this kind

Elements of Ontario Regulation 128/04 which did not reflect provincial standards in this area are as follows:

- Operators were not provided with the minimum annual number of hours of training. Some in-house training has been provided, however, plant personnel have not attended formalized training sessions for as much as two years.
- Records of any previous training are not being maintained.

3.3.7 Water Quality Monitoring

Current Test Schedule
As determined during the physical assessment of the Kashechewan WTP on October 29, 2005, the following are the previous sampling schedules for microbiological and physical/chemical parameters:

Microbiological Testing:
- 4 distribution system samples collected weekly and analyzed for E. coli and Total Coliforms at an accredited lab

Physical and Chemical Testing:
- 1 sample is collected annually and analyzed for Arsenic, Barium, Cadmium, Chromium, Fluoride, Lead, Mercury, Nitrate and Nitrite (as nitrogen), Sodium, Trichloroethylene, Trihalomethane, Turbidity.

It should be noted that the current testing practices at the Kashechewan Drinking Water System do not reflect the microbiological and physical/chemical test requirements of Ontario Regulation 170/03.

Ontario Regulation 170/03 Microbiological Test Requirements:
The microbiological testing requirements of Ontario Regulation 170/03 for an equivalent municipal system are as follows:
- 1 sample is collected weekly from raw water intake and analyzed for E. coli and Total Coliforms
- 8 samples are collected monthly from distribution system sites and analyzed for E. coli, Total Coliforms and 25% of those analyzed for either heterotrophic plate count or general background population.
- 1 sample is collected weekly of treated water and analyzed for E. coli, Total Coliforms and either heterotrophic plate count or general background colonies

Ontario Regulation 170/03 Physical and Chemical Test Requirements:
The physical/chemical testing requirements of Ontario Regulation 170/03 are as follows:
- Chlorine residual - Continuous analysis at the point where primary disinfection has been satisfied to ensure adequate primary disinfectant residual
- Chlorine residual – minimum of 1 sample daily from the distribution system for the determination of free chlorine residual to ensure adequate secondary disinfection.
- Turbidity - Continuous analysis on each filter effluent line.
- Schedule 23 Inorganics - 1 sample of treated water taken every 12 months
- Schedule 24 Organics - 1 sample of treated water taken every 12 months
- Lead - 1 sample from distribution system likely to contain elevated lead every 12 months
- Trihalomethanes - 1 sample from distribution system likely to contain elevated THM every 3 months

- Nitrate/Nitrite - 1 sample of treated water taken every 3 months
- Sodium - 1 sample of treated water taken every 60 months

The following is a listing of additional observations made at the Kashechewan drinking water system related to water quality monitoring that generally fall in line with the requirements of Ontario Regulation 170/03:

- Samples for chlorine residual analysis are being tested using continuous monitoring equipment.
- The current monitoring equipment is capable of measuring chlorine residuals with the required accuracy.
- The primary disinfection chlorine monitoring is being conducted at or near a location where the intended CT has just been achieved or at a point representing that location, which is the discharge of treated water from the clearwells.
- Turbidity testing is being done using a portable meter that measures turbidity in Nephelometric Turbidity Units (NTUs).
- The testing for parameters required by this legislation is being conducted by laboratories accredited to test for that parameter. Maxxam Analytics Inc. and Near North labs have been used to perform analysis for this facility.
- Based on information provided by the plant personnel, samples are being taken and handled in accordance with instructions provided by the drinking water system's laboratories.

The following is a listing of additional observations made at the Kashechewan drinking water system related to water quality monitoring that would need to be addressed in order to be in compliance with the requirements of Ontario Regulation 170/03:

- Raw water samples are not collected prior to treatment and analyzed at the appropriate frequency for microbiological parameters.
- Continuous disinfectant residual analyzers are not equipped with alarms to ensure continuous disinfection.
- Continuous water quality analyzers and indicators with alarm systems are not installed at the prescribed locations.
- Continuous water quality analyzers and indicators with alarm systems have not been calibrated, maintained and operated in accordance with the manufacturer's instructions or the regulation.
- Operators cannot examine continuous monitoring test results nor are they examining the results within 72 hours of the test since there are no data recording devices connected to continuous analyzers and flow meters.
- The secondary disinfectant residual is not measured and recorded daily for the distribution system as required.
- The records indicate that free chlorine residual levels in the distribution system were less than 0.05 mg/L on a number of occasions during the last nine months

- Records confirm that chorine residual tests are not being conducted on a consistent basis at the same time and at the same location that microbiological samples are obtained in the distribution system and treated water.
- The drinking-water system is practising chemically-assisted filtration, and continuous monitoring of each filter effluent line for turbidity is not being performed as required.
- The drinking-water system owner has not submitted written notices to the Director that identifies the laboratories that are conducting tests for parameters required by legislation.
- A records archiving system has not been established and the required records are not being kept for, specifically for 5 years and 15 years.

Additional observations made relative to the water quality monitoring undertaken at the Kashechewan WTP include the following:

- For raw water sample collection, a tap is available to obtain samples before any chemicals or disinfectants are added. The tap itself is not of an acceptable smooth nozzle construction. This should be replaced accordingly.
- The newly contracted operating authority indicated that it is too early to establish defined water quality goals, but there is the intent to do so once the process has been stabilized.
- Operations personnel regularly monitor filter head loss and filter effluent turbidity in order to determine when a filter requires backwashing.
- In addition to sampling for required parameters, the plant personnel perform a number of additional tests including; raw and treated water temperature, pH, turbidity, color, and pre-filter water turbidity.
- Based on a limited number of distribution system records, the indication is that free chlorine residuals are maintained less than 4.0 mg/l.
- Records generally reflect that distribution system samples have been collected at the extremities and at “dead-ends” of the system.
- The plant personnel routinely monitor turbidity levels as process water exits the sedimentation process (clarifier)

As part of this assessment, Ministry staff collected the following water samples for the purposes of the specified analyses:

- Distribution System on October 29, 2005 (Seven sample sites)
  - Microbiological parameters (total coliform, E. coli, background colonies)
  - Turbidity and free chlorine residual (on-site measurement at each location)
  - Trihalomethanes and lead (from each of the seven sample sites)

- Treated Water on October 30, 2005 (from the treated water clearwells)
  - Microbiological parameters (total coliform, E. coli, background colonies)
  - Turbidity and free chlorine residual (on-site measurement)
  - All Ontario Regulation 169/03 parameters for which municipal drinking water systems are required to test.

- Raw Water on October 30, 2005 (discharge from the low lift pump header pipe)
  - Turbidity (on-site measurement)
  - All Ontario Regulation 169/03 parameters as above (Municipal drinking water systems are not required to test raw water for all of these parameters. These tests were completed for the purposes of additional information)

- Distribution System on October 30, 2005 (Six sample sites)
  - Microbiological parameters (total coliform, E. coli, background colonies)
  - Turbidity and free chlorine residual (on-site measurement at each location)
  - Trihalomethanes and lead (from each of the six sample sites)

3.3.8 Water Quality Assessment

Based on analysis of samples taken on October 29 and 30, 2005, it has been confirmed that the water provided to the drinking water system meets the requirements of the prescribed Ontario Drinking-Water Quality Standards. Refer to the table of analytical results as per Appendix D.

3.3.9 Reporting, Notification and Corrective Actions

According to the local plant personnel, incidents of samples with low free chlorine and presence of microbiological parameters are reported to the Band Office in Kashechewan and to officials at Health Canada.

In terms of the reporting of adverse test results, subsequent corrective actions, and notice of issue resolution, there does not appear to be a clearly defined protocol that is equivalent to the current provincial standards.

The protocol for the reporting of adverse test results, subsequent corrective actions, and notice of issue resolution as required by Ontario Regulation 170/03 includes the following elements:

- The duty to report adverse tests and other observations
- The application of specific corrective actions based on the nature of the adverse condition
- The manner in which the report is to be made immediately verbally and within 24 hours by written notice
- The prescribed content of the report and notice
- A notice of issue resolution when the adverse condition has been eliminated

It was also observed during the physical assessment of the process equipment at the Kashechewan WTP that there is no alarm connected to the continuous free chlorine analyzer. This finding leads to additional inconsistencies with the following elements of the provincial standards:

- In instances where alarms for continuous monitoring equipment have sounded, appropriate actions are to be taken in a timely manner by a qualified person(s).
- If no one was at the location where/when an alarm from the continuous monitoring equipment sounded, a qualified person must be promptly dispatched.
- When qualified persons are dispatched for alarms from continuous monitoring equipment, they are required to be available such that they can arrive at the location as soon as possible.

It was also observed during the physical assessment of the Kashechewan drinking water system that there was no requirement similar to that of Ontario Regulation 170/03, for the creation of a "performance report" related specifically to the operations, monitoring and maintenance of the drinking water system. Municipal facilities subject to Ontario Regulation 170/03 are required to create two specific reports, namely "Annual Reports" and "Summary Reports For Municipalities".

In general terms, the Annual Report must satisfy the following requirements:

- contain a brief description of the drinking water system, including a list of water treatment chemicals used by the system during the period covered by the report
- Summarize any reports of adverse water quality and other conditions made during the reporting period
- Summarize the results of all tests required under both the Ontario Regulation 170/03 and a Certificate of Approval
- Describe any corrective actions taken to resolve reports of adverse water quality and other conditions made during the reporting period
- Describe any major expenses incurred during the period covered by the report to install, repair or replace required equipment
- Include a statement of where "Summary Reports For Municipalities" will be available for inspection by the users of the system
- The owner of a drinking-water system shall ensure that a copy of an annual report for the system is given, without charge, to every person who requests a copy
- A report must be kept available for a period of at least two years
- Effective steps must be taken to advise users of water from the system that copies of the report are available, without charge, and of how a copy may be obtained

In general terms, the "Summary Reports For Municipalities" must satisfy the following requirements:

- A report is prepared by no later than March 31 of the following year
- The report must by provided to the members of the municipal council
- List the requirements of the Act, the regulations, and the system's approval that the system failed to meet at any time during the period covered by the report and specify the duration of the specific failures
- For each failure, describe the measures that were taken to correct the failure
- The report must contain a summary of the quantities and flow rates of the water supplied during the period covered by the report, including monthly average and maximum daily flows and daily instantaneous peak flow rates

- The report must contain a comparison of the water flow summary maximums to the rated capacity and flow rates approved in the system's approval.

3.3.10 Recommendations – Water System Management Practices

The Table below summarizes key recommendations relating to current water system management practices at the Kashechewan WTP.

Operations Manuals
Long-term (within 2 years)

- Create and maintain a comprehensive operations manual that integrates requirements for new equipment as it is commissioned.

Logbooks
Immediate

- Create and maintain comprehensive logbooks that reflect requirements of current provincial standards to record information related to operation and maintenance of equipment.

Contingency and Emergency Planning
Immediate

- Establish plans and adequate procedures for the provision of materials and equipment to deal with emergencies, upsets, and equipment breakdowns.

Medium-term (within 1 year)

- Ensure there is a dedicated standby power generator set.
- Ensure sufficient inventory of spare parts is maintained on-site and consider the installation of a second process train (back-up).

Communication with Consumers
Medium-term (within 1 year)

- Establish a procedure for the recording and resolution of complaints made by users of the system.

Operator Certification and Training
Immediate

- Conduct an assessment of current knowledge base of staff and assess specific training needs.
- Maintain a level 2 (minimum) operator on-site on 24 hours a day, 7 days a week.

Long-term (within 2 years)

- Establish a training policy that includes opportunities for ongoing learning.
- Provide SCADA control with the capability for remote monitoring and operation.

Water Quality Monitoring
Immediate

- Establish a comprehensive sample plan based on current provincial standards for the drinking water system that ensures samples are collected and analyzed regularly at an accredited laboratory.

Reporting, Notification and Corrective Actions
Immediate

- Establish protocols for adverse water quality incidents to ensure that appropriate corrective actions are taken. This would require defining adverse incidents, how reporting and notification will happen, what corrective action is appropriate, and how the incident will be considered resolved.
- Establish operator log and in-plant data recording to allow past performance to be assessed, and trends to be identified.

Medium-term (within 1 year)

- Once alarms are installed, establish a protocol for receiving/responding to alarms at the local level (call-out system)

Long-term (within 2 years)

- Consider options for communication of system performance to the community and implement the selected strategy.

APPENDIX B:

Technical Assessment of the Kashechewan Sewage System

Kashechewan First Nation
Communal Sewage Assessment Report

November 10, 2005

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1.0 Introduction:

On October 28, 2005, Ministry of the Environment (ministry) staff initiated an assessment of the sewage collection and treatment system serving the Kashechewan First Nation. This community is located on the north bank of the Albany River within the Hudson Bay Lowlands, approximately 10 km upstream of James Bay (Figure 1) and 450 km north of Timmins, Ontario. The community is located within the territorial District of Kenora.

The Kashechewan First Nation Water Treatment Plant provides treated drinking water to the community. The raw water source is the Red Willow Creek. This creek flows into the Albany River which ultimately flows into James Bay. The raw water intake for the plant is a 200 mm diameter pipe that extends approximately 90 m into the creek. The intake crib (i.e. the end of the pipe) is located just upstream of the confluence of Red Willow Creek and the Albany River. The area experiences tidal influences, causing a regular reversal in flow within both the Albany River and Red Willow Creek. Two sources of potential contamination of the drinking water supply were evaluated during this assessment – the sewage collection system and the sewage treatment facility.

This assessment was completed on October 30, 2005. It was conducted in the presence of an operator of the sewage collection and treatment system. His time afforded to this assessment, and that of other Kashechewan First Nation members, was greatly appreciated.

2.0 Statement of Objectives:

Communal sewage systems within the Province of Ontario require approval under the *Ontario Water Resources Act*. An approval for such a system, issued by the ministry, would typically contain requirements for construction, operation and maintenance. Assessments are routinely conducted by ministry staff at these facilities to determine compliance with the conditions specified in the approval document(s) and related legislative requirements.

The ministry's assessment of the sewage collection system and the sewage treatment facility serving the Kashechewan First Nation was conducted with the objective of:

- Making recommendations to improve the operation of the system and facility where appropriate to protect the surface drinking water source from potential impacts of sewage disposal.

In order to achieve this objective, the following targets were established:

- Provide an overview of the existing sewage collection system and sewage treatment facility.
- Provide a comparative evaluation of the existing sewage collection system and sewage treatment facility in light of original design information (where available) with ministry standards and guidelines.
- Highlight issues of concern with regard to the operation of the sewage collection system and the sewage treatment facility in general, and more specifically, in relation to potential impacts of sewage disposal on the community's surface drinking water source.

Fulfillment of the objective and targets stated above required:

- a review of available engineer/consultant reports, maintenance and operational plans, monitoring reports, ministry standards and guidelines and operational practices from other similar systems;
- visual observation of both the collection and treatment systems;
- interviewing system operators (when available);
- contacting external agencies who may have been involved with the design and/or operation of the system; and
- interpretation of analytical results obtained from samples taken from in and around the system during this assessment and by other staff involved with its historical operation.

Figures and tables referenced within this report can be found in Appendix C.

3.0 Sewage Collection System:

3.1 Overview:

The Kashechewan First Nation sewage collection system is illustrated in Figure 4. It is composed of three sewage lift stations (LS-1, LS-2 and LS-3), forcemains and gravity sewers. Sewage is collected in LS-3 from adjoining areas and pumped to a nearby maintenance hole (MH-3). Sewage then flows by gravity to LS-2 where it is again lifted to a nearby maintenance hole (MH-2). From MH-2, sewage flows by gravity to LS-1 via an overflow maintenance hole (MH-Overflow). The purpose of MH-Overflow is to direct raw sewage to the Albany River via the overflow sewer should LS-1 fail. During pump failures at LS-3 and LS-2, (as was the situation during this site visit), sewage flows to MH-3 and MH-2, respectively, by gravity.

3.2 Assessment Observations:

It was observed during the site visit that LS-3 and LS-2 were not functioning because the pumps were out of order. LS-1 was in operation. Pump sizes at the lift stations could not be identified except that the two pumps operating at LS-1 had motor sizes of 5 and 10 horsepower. The two pumps were reportedly operating continuously regardless of the liquid level within the wet well due to a previous failure of the automatic pump shut-off device (i.e. float switch). It was determined that since LS-3 and LS-2 were not operational, a failure at LS-1 would lead to sewage back-up within the collection system. The operator indicated that there is a red light at the LS-1 station that flashes when there is a problem at the lift station; however, it is often found to be broken and the operator relies on his own observations or notification from nearby residents that there is a suspected problem at the station.

Wet wells at LS-1 and LS-3 could not be inspected because the access hatches could not be opened at the time of the assessment (they had been previously secured by operators to prevent entry by unauthorized personnel). The wet well at LS-2 was observed through the open hatch to be partially full of sewage material.

It was reported by the operator that there were no overflow facilities (e.g. overflow pipes) at any of the lift stations. Therefore, it was induced that the only way for sewage to overflow the wet wells would be to flow out the access hatches or through nearby lower lying maintenance holes. During the visit of the lift stations, there was no sewage observed on the ground in the vicinity of maintenance holes or lift stations that would have indicated previous overflow occurrences. Upon further inquiry, it was reported that lift stations have not overflowed in recent years and should sewage back up in the system, it was more likely to be discharged out of the overflow sewer to the Albany River. This overflow sewer is located upstream of the confluence of Red Willow Creek with the Albany River.

The discharge end of the overflow sewer, located adjacent to the shoreline of the Albany River, was assessed. It appeared that there was at one time an outlet structure on the end of the overflow sewer. At the time of the site visit, the structure was broken and the overflow sewer lay extruding through the dyke embankment next to the shoreline of the Albany River. The backflow prevention device was seen lying on the shoreline just downstream of the overflow location. The operator reported that this device had been broken off by ice movement within the river during the previous spring melt. The positioning of the overflow sewer indicates that normally, discharge into the river occurs at a higher elevation than the normal river water level. However, during periods of high water level and in the absence of a backflow device, river water may flow back into the community through the overflow maintenance hole.

It was observed during the assessment that there is no dedicated standby power for the operation of the sewage collection system.

3.3 Issues of Concern:

Based on the site observations, the following four issues of concern are identified:

i) Non-operation of LS-2 and LS-3;
ii) Potential contamination of the surface drinking water supply by overflow from the sewage collection facility;
iii) River backflow into the sewage collection system through overflow sewer; and
iv) There is no dedicated standby power supply for the sewage collection system.

The failure of LS-2 and LS-3 could potentially reduce storage capacity within the sewage collection system. Under these conditions, should LS-1 fail, the potential of an overflow of sewage to the Albany River may increase.

The overflow sewer is located adjacent to the shoreline of the Albany River, upstream of the surface drinking water supply intake which is within the Red Willow Creek. Tidal influences experienced in the area could potentially transport contamination along the shoreline of the Albany River and into Red Willow Creek near the drinking water intake.

The potential for the Albany River to backflow into the sewage collection system through the overflow maintenance hole (MH-Overflow) is critical. Should the river water level rise above the overflow sewer crown, it will force raw sewage to overflow from the maintenance holes and flood the community, potentially resulting in serious human health impacts.

There is no dedicated standby power supply for the sewage collection system. There is a potential for raw sewage to overflow to the Albany River during a power supply outage.

3.4 Recommendations:

The following summarizes key recommendations relating to the sewage treatment system as observed during this assessment:

Immediate:

i) Repair/replace pumps in lift stations 2 and 3, maintain a spare parts inventory including at least one spare pump at all times, and perform other necessary maintenance to make lift stations functional.
ii) Repair/replace automatic shut-off device for lift station 1 to prevent the pumps from operating continuously when not required.
iii) Install alarms which are monitored in a staffed location (e.g. at the water treatment plant) that self-activate under abnormal conditions (e.g. pump failure, high water level) so that appropriate action can be taken as required.

iv) As an interim strategy, any raw sewage overflow into the Albany River should be responded to by ensuring immediate notification to water treatment plant staff.
v) Repair/replace the overflow sewer and backflow prevention device because backflow potential exists.

Medium-term (within 1 year):
vi) A contingency plan be developed and implemented to address potential contamination of the drinking water supply during overflow occurrences (e.g. procedures for notification and response to alarms, an evaluation of potential disinfection of the overflow, and installation and maintenance of a standby power supply).

Long-term (within 2 years):
vii) Develop and implement an Operations Manual, Preventative Maintenance Program, and Operator Training Program.
viii) Assess potential of alternate overflow location and configuration.

4.0 Sewage Treatment Facility:

4.1 Overview:

The Sewage Treatment Facility is located immediately north-east of the community, on the north-east side of Red Willow Creek (Figure 2). The community of Kashechewan First Nation is located on the opposite shore. The facility consists of two individual waste stabilization ponds (i.e. lagoons), cell 1 and cell 2 (Figure 5). Cell 1, constructed in about 1988, is reported to have a working capacity of 83,200 m^3. As determined from a review of available engineering reports, the working capacity of cell 2, constructed in about 1999/2000, is 104,000 m^3. It was noted in a previous consultant report that cell 2 did not become operational until November 2001. In addition, Health Canada reported that cell 2 was not used immediately after its construction due to problems associated with the outfall piping.

The December 2002 Operations Manual indicates that lagoon cells were designed to discharge on a seasonal 7-day discharge basis, including one discharge period in the spring and one in the fall of each year.

Raw sewage is pumped by LS-1 via a 250 mm polyethylene pipe running under Red Willow Creek to the distribution chamber located on the south side of the lagoons (Figure 5). This chamber houses four 250 mm gate valves. Two valves control the flow of water into the two existing cells. The two other valves were installed to control the flow of sewage into two future cells that have not yet been constructed. Sewage is either discharged into a bermed area within the south-west corner of cell 1 or the north-west corner of cell 2.

Following retention, the clarified effluent is discharged from either cell through the discharge chamber located at the north-east corner of cell 1 (Figure 5). This chamber houses four 400 mm diameter discharge pipes. Two of these pipes are used to convey treated sewage from cells 1 and 2. The two other pipes will convey treated sewage from two future cells that have not yet been constructed. The discharge pipe from cell 1 is controlled by a sluice gate in the discharge chamber. The discharge from cell 2 is controlled by a 400 mm diameter valve on the discharge pipe located inside the discharge chamber.

Treated effluent from the discharge chamber enters a 5 m wide ditch that leads to East Creek. East Creek flows in a north-easterly direction for a distance of approximately 8 km from the sewage lagoons towards James Bay (Figure 6).

To prevent overloading of the two cells, an overflow pipe was installed on the separator berm between the two cells. A previous consultants' report notes the presence of a 300 mm gate valve on this overflow pipe. There is also a 300 mm overflow pipe at the north-east corner of cell 1 which conveys overflow, when it occurs, into the discharge chamber.

4.2 Design Operation:

As stated in the December 2002 Operations Manual, the lagoons were designed with the intention of collecting sewage for six months per year in one cell, allowing it to rest for a period of 60 days or 2 months, and then discharging the treated effluent to the environment via East Creek. While this cell was being rested, raw sewage would be collected in the other cell for the other six months of the year. The rested cell would be drained by opening up the appropriate valve to allow treated effluent to enter the discharge chamber. Discharge from a cell was to occur over a period of 7 days. This discharge schedule was further refined in the Operations Manual.

The author of the Operations Manual took into consideration that it was preferable that treated effluent be released during periods of high water flow to lessen the potential impact of the effluent on the receiving environment. This period of high water flow is typically experienced following spring melt and during the fall when increased precipitation falls in the area. Following this schedule, discharge from the facility would typically occur during spring and fall months.

The manual also considered the long winters and short summers experienced in the Hudson Bay Lowlands and the capacity of the two cells. That is, since cell 2 has a higher working capacity than cell 1, the Operations Manual indicates usage of cell 2 primarily during the winter months and cell 1 primarily during the summer months. However, the manual states that if at any time, a cell reaches it maximum level; it should be immediately rested for 60 days in preparation of discharge. The maximum operating water level for the cells was not apparent at the time of this assessment.

Prior to the release of treated effluent, the manual states that permission was to be obtained from Health Canada to ensure water quality testing had been conducted and was found to be acceptable in comparison to federal guidelines prior to its release. The discharge pathway, i.e. the outlet ditch and East Creek, were to be freed of obstruction (e.g. beaver dams) prior to discharge occurring. It is stated in the manual that this action is critical as obstructions to flow within the creek may cause the flow and lagoon discharge within East Creek to reverse such that it flows back and enters Red Willow Creek upstream of the Kashechewan First Nation surface drinking water supply intake.

4.3 Assessment Observations:

Design and Construction:

Sewage treatment lagoons, similar to the facility serving the Kashechewan First Nation, are widely used in smaller communities in Ontario. Lagoons are considered to provide the required level of treatment at a considerably lower cost than mechanical sewage treatment systems. Ministry guidelines entitled "Guidelines for the Design of Sewage Treatment Works" dated 1984 provide the basis for the design of sewage treatment lagoons in Ontario. A comparative evaluation of the main design features of the Kashechewan First Nation sewage lagoons with the design guidelines was undertaken as part of this assessment and is summarized below.

Comparative Evaluation of Main Design Features of Kashechewan Sewage Lagoons with Ministry of the Environment Design Guidelines.

Design Characteristic	**Kashechewan First Nation Lagoons**	**MOE Guidelines**	**Remarks**
Number of cells	2	2 or more	Meets the Guidelines
Operating depth	1.8 m	1.8 m (max)	Meets the Guidelines
Size of cells	Cell 1 = 4.6 ha [Note 1] Cell 2 = 5.8 ha [Note 1]	Less than 8.0 ha	Meets the Guidelines
Cell Geometry	Cell 1: rectangular with low L:W ratio (not a long narrow rectangular cell) Cell 2: almost square	Square cells preferred to long narrow rectangular cells	Meets the Guidelines
BOD_5 loading	13 kg-BOD_5/ha/d [Note 2]	< 22 kg-BOD_5/ha/d	Meets the Guidelines
Freeboard	Data not available	0.6 m	Undetermined.
Inlet chamber	Available with split arrangement	Required to split hydraulic and organic loads to cells	Meets the Guidelines
Emergency overflow system	Available	Required	Meets the Guidelines

Cross connection piping	Available	To be provided	Meets the Guidelines

Note 1 Estimated calculations.

Note 2 Based on population of 1,800 people at the design sewage generation rate of 180 L/c/d and 75 g-BOD_5/c/d.

Review of the above comparison indicates that the Kashechewan sewage lagoons for the most part meet the ministry's design guidelines.

Distribution and Discharge Chambers:

During the assessment, access to the distribution and discharge chambers was prevented by an accumulation of water and sewage within the chambers. Visual observations, therefore, were made only by opening the hatches and looking into the chambers.

Most of the valves located within the chambers were not visible above the water level. Their operation therefore, could not be tested as part of this assessment. A previous assessment, however, conducted by a consultant on October 29, 2002, determined that the valves within the chambers were operable within their full range of motion.

It was reported by the operator during this assessment that the mechanism used to open or close the valves was missing from the discharge chamber. In addition, debris was observed to be floating on the water's surface within the discharge chamber. This material could obstruct flow through the chamber and may indicate that repairs to the chamber are required.

Internal Berms (Inlet Structures and Separator Berm):

The internal berms surrounding the inlet of cell 1 were visible during this assessment. The operator reported that the valve on the internal east-west inlet berm had been left open to allow sewage to pass easily into the remaining area of cell 1. Sewage conveyed to the pond could also flow through a space in the north-south running berm. Whether this space in the berm was constructed as designed or resulted from erosion due to some historical overflow was not known at the time of this assessment.

The internal berms surrounding the inlet structure of cell 2 were not visible above the water level within the pond on the day of this assessment. It was reported by the operator that the internal berms of cell 2 had been eroded by the high water level.

A breach was observed on the separator berm between the two cells. This breach, located at the same location as the overflow pipe, was causing the overflow of water from cell 2 into cell 1. The overflow pipe was visible at one end. The water however, appeared to be flowing over and around the overflow pipe. The breach may have been caused by high water levels in cell 2 and blockage of the overflow pipe. A previous consultant's

evaluation revealed that there is a valve on this pipe but that it could not be located to assess its function. This valve was not observed during this assessment.

Cell Operation and Discharge:

On the day of this assessment, raw sewage was being conveyed to the inlet of cell 2. Cell 2 was actively overflowing through the breach in the internal berm into cell 1. Discharge from cell 1 was observed to be flowing into the discharge chamber. The operator reported that the discharge gate from cell 1 had been left open partially to allow this discharge to occur. A review of pertinent files revealed that this discharge had likely been occurring continuously since the breach between the two cells occurred and at least since some time in 2004. The operator did note, however, that cell 1 had been emptied during the spring of 2005.

As reported by the operator during the assessment, cell 1 was being allowed to continuously discharge to control the water level within cell 1 since water from cell 2 was continuously flowing into it. Cell 1 was approximately 25 to 50% full at the time of this assessment. The water level was well below the invert elevation of the overflow pipe. However, there was no water level measuring device apparent during the assessment in either cell to determine how water levels compared to the maximum operating water level, referred to in the Operations Manual. It is advised that some type of water level measuring device (e.g. staff gauge) be installed in the cells and monitored on a regular basis.

From the file review conducted in relation to this assessment, it was determined that because of the breach between the two cells, cell 2 is being used as the primary receiver of sewage from the distribution chamber. That is, the discharge of raw sewage was not being alternated between the two cells in accordance with the Operations Manual.

Final Effluent Monitoring:

In the operation of the Kashechewan First Nation sewage treatment facility, samples are obtained prior to discharge occurring. As reported during the assessment, these pre-discharge samples are obtained either by Health Canada or by operators at the direction of Health Canada. It is understood that no monitoring of raw sewage or of the final effluent is conducted.

Sampling and analysis for seasonal discharge lagoons in Ontario are typically conducted in accordance with the ministry's procedure F-10 entitled "Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only)". Typical sampling and analytical requirements are summarized in Table 1. Fulfillment of monitoring, such as that listed in the table, allows for on-going evaluation of the treatment works' performance.

A review of analytical information obtained from samples taken by Health Canada during the time period of 2000 to 2005 and during this assessment (sample station KTSP-3),

reveals that the quality of effluent being discharged continuously from cell 1 is meeting federal, as stated on Health Canada correspondence, and provincial guidelines for sewage effluent criteria. These results are summarized in Table 2. Since effluent quality has been meeting guideline effluent criteria, no impact from this discharge on the environment was anticipated at the time of this assessment.

During the assessment, the operator reported the intention of discharging cell 2 in the very near future (i.e. November 2005) and that permission for discharge, based upon pre-discharge sample results, had been granted by Health Canada. When questioned, the operator indicated that it was planned that the conveyance of raw sewage into cell 2 would continue even during the planned discharge from the cell. It was noted from discussion with the operator that the outlet for discharge from cell 2 is in the same internal bermed area as the inlet. Though this could not be confirmed on as-constructed drawings, it suggests that the potential exists for insufficiently treated sewage to circumvent treatment by flowing directly to the outlet pipe during the discharge period. Additionally, this indicates that the rest period of 60 days or two months for a cell prior to initiating discharge, as recommended in the Operations Manual, would not be accomplished prior to this discharge occurring. This rest period allows time for biological activity to reduce nutrient loading on the environment and permits heavy materials to settle out of the water column prior to discharge.

A sample of water from cell 2 was obtained during the site visit (KSTP-2). The results, as shown in Table 2, revealed water quality meeting federal and provincial guidelines for effluent discharge. It should be noted however, that recent precipitation experienced in the area may have diluted the water within the cell and that these results may not be indicative of the normal performance of the sewage treatment facility. The sample obtained of raw sewage from the distribution chamber (KSTP-1) was found to be considerably dilute.

The operator reported during the assessment that the last samples obtained by the operator were taken off of the internal berm separating the two lagoons. A lack of proper sampling equipment (e.g. sample pole) was noted during an ensuing discussion with the operator.

Final Effluent Discharge:

As reported by the operator, emptying of cell 2 was to occur in the immediate future over a time period of approximately 2 to 3 days. The Operations Manual notes that discharge is to be carried out over a 7 day period. A longer discharge period would minimize: dislodging of sediment/sludges that have accumulated around the outlet from the pond; the potential for backflow in East Creek and eventually to Red Willow Creek; and scouring (i.e. erosion) of the discharge path and East Creek. Longer discharge periods are typically undertaken at similar facilities in Ontario.

In order to fully understand the impact of effluent discharge on any receiving water body, it is important that the flow rate of effluent be measured. Flow information is also

valuable for planning discharge schedules and for capacity approximations. Whereas the ministry requires flow measuring from sewage treatment plants in Ontario in general, it was observed that discharge from the lagoon was not being monitored.

Final Effluent Disinfection:

Discharge from sewage works to surface waters may constitute a significant input source of micro-organisms to the receiving waters. Normally, final effluent disinfection is not required. However, at some Ontario facilities, where special concerns exist, final effluent disinfection may be preferred. There is no final effluent disinfection associated with the Kashechewan First Nation sewage treatment facility. This measure may be considered for inclusion in a contingency plan for the protection of the surface drinking water supply should the reversal of discharged effluent into Red Willow Creek occur.

Receiver Monitoring:

East Creek, the primary receiver of effluent from the sewage lagoons, is subject to obstruction by beaver activity. It was reported by the operator that obstructions in East Creek causes discharged effluent to back up in East Creek and to flow into Red Willow Creek. The location of entry of East Creek flow into Red Willow Creek is generally upstream of the drinking water intake; however, this location becomes downstream when the Red Willow Creek reverses its flow due to tidal effect.

Visual observations of the creek during the site visit, where access was permitted, revealed no flows within the creek. In addition, aerial surveillance revealed what appeared to be the presence of at least two separate beaver dams between the sewage lagoons and James Bay. Though there is no direct linkage between East Creek and Red Willow Creek, the operator noted that once the water level in East Creek gets high enough, it will overflow and drain through the bush to Red Willow Creek. The path this flow takes through the bush was pointed out by the operator based upon his previous observations of this occurrence.

The operator noted that following removal of beaver dams approximately 2 years ago, flow was observed going straight towards James Bay. This statement was supported by findings of a consultant who, in a 2002 report, noted that flow in East Creek was re-established following the removal of beaver dams within the creek. This issue was also addressed in the Operations Manual which states that prior to any discharge occurring, all obstructions to flow within the discharge ditch and East Creek are to be removed. Without this work being accomplished, it is expected that the discharge of effluent from cell 2 will back up into Red Willow Creek.

The discharge route between the discharge chamber and East Creek was observed to be full of vegetative growth (i.e. cattails) during the assessment. Excessive vegetative growth may hinder flow and make access to East Creek difficult.

There was no indication that water quality monitoring of East Creek or Red Willow Creek is regularly conducted with the exception of raw water analysis in relation to the water treatment plant. Generally, sensitive receivers are routinely monitored throughout the province during the sewage treatment plant discharge periods. Since seasonal discharges imply high flows and elevated organic and nutrient loading rates, regular monitoring of the potential impacts within the receiver should be undertaken.

A basic sampling program was conducted as part of this assessment. These sample sites are illustrated in Figure 2. The analytical results obtained from these samples are summarized in the attached Appendix D. Samples were obtained from Red Willow Creek at locations upstream (RWK-UP) and downstream of the community's storm water outflow (RWK-DWN1), and downstream near its confluence with the Albany River (RWK-DWN2). Samples were also obtained at an upstream sample location on the Albany River (AR-UP) and from East Creek at its confluence with discharge from the sewage lagoon (KSTP-4) and upstream where the creek is crossed by the winter road (KSTP-5). A review of this analysis reveals that water quality within Red Willow Creek did not vary significantly between upstream and downstream stations. In addition, there was no indication of an abnormal concentration of any water quality parameter within samples taken from East Creek, Red Willow Creek and the Albany River.

Reporting Requirements:

Ontario facilities similar to the Kashechewan First Nation sewage treatment facility are typically required to submit reports as a condition of the approval document issued by the ministry. The purpose of reporting is to provide a performance record for future reference, to ensure that the owners/operators are made aware of problems as they arise, and to provide a review of the operation of the sewage treatment plant to permit the resolution of any problems in a timely manner.

During the assessment, the facility operator indicated that Health Canada is contacted prior to initiating discharge from either cell; however, whether formalized data sharing and reporting is occurring on a regular basis is not known. In addition, records of lagoon discharge frequency do not appear to be maintained by operators.

Facility and Operator Certification and Training:

Ontario Regulation 129/04, pursuant to the *Ontario Water Resources Act*, specifies facility and operator certification and training requirements for sewage works operators in Ontario. Operators of sewage works located on reserve lands will sometimes apply for certification. However, from a review of ministry records, this does not seem to be the case for this system. In addition, it was reported during the assessment that operator training is limited.

Maintenance Program:

Maintenance actions in relation to the sewage treatment facility appeared to be limited. Ontario facilities are typically required to develop a maintenance program as a condition in the approval document issued by the ministry.

Previous consultant reports recommended monthly inspection of all valves. Though it was not confirmed, it was suggested during the assessment that this is not being accomplished.

Vegetative growth along the outside berm of cell 1 appeared to be advanced with many small trees present. Vegetative growth around the circumference of the lagoons was present but did not appear to be so excessive that it would interfere with the proper operation of the lagoon.

There is currently no management plan for the accumulating sludge within the lagoon cells. However, the lagoon was designed such that future expansion could be accommodated as required. Capacity was not identified as being an issue during this assessment. However, there appears to be a lack of performance measurement (e.g. water level monitoring and final effluent flow monitoring), to assess capacity on an ongoing basis.

Contingency Planning:

Whether a contingency plan exists for the sewage treatment facility was not indicated during the assessment.

4.4 Issues of Concern:

Based upon observations made during this assessment and a review of pertinent files, procedures and guidelines, the following issues of concern are identified:

i. The overflow of water from cell 2 into cell 1 appears to have prompted the continuous discharge of effluent from cell 1. Although this overflow does not appear to be presenting a risk for environmental impairment, its presence has caused the operation to deviate from the original operational design. That is, the continuous discharge from cell 1 has prompted operators to use cell 2 as the primary receiver of raw sewage and therefore, the cells are not being filled and rested in accordance with the designed alternating schedule. This presents a risk that insufficiently treated sewage, mainly from cell 2 when it is emptied via the outlet valve, could potentially be discharged to the environment. Additionally, the unimpeded overflow of water from cell 2 to cell 1 could cause further erosion and instability to the internal berm structure.

ii. The presence of obstructions within East Creek presents a risk that discharged effluent will back up into Red Willow Creek, upstream of the surface drinking water supply intake for the community of Kashechewan First Nation.

iii. The facility operator indicated the intention to discharge cell 2 in the near future (November 2005) over a 2 to 3 day period. The Operations Manual recommends a 7 day discharge period. The reduced discharge period will increase the risk of solids being released with the discharge, the scouring of the receiving environment, and the potential that East Creek will not be able to accommodate the flows. This may cause the creek to back up and flow into Red Willow Creek which would present a potential contamination risk to the downstream surface drinking water intake.

iv. There is no contingency plan to address the potential discharge of lagoon effluent into Red Willow Creek.

v. There appears to be a lack of regular operator training in the proper operation, inspection and maintenance of the sewage treatment facility.

vi. There appears to be a lack of record retention detailing the day-to-day operation and maintenance of the sewage treatment facility.

vii. The absence of a mechanism to manipulate valves within the discharge chamber, as noted by the facility operator, could cause problems with lagoon operation.

viii. There appears to be a lack of monitoring conducted in relation to the discharged effluent and potential receivers of the discharge effluent (i.e. East Creek and Red Willow Creek). In addition, there also appears to be no formalized reporting mechanism.

4.5 Recommendations:

Based upon observations made during this assessment and a review of pertinent available files, procedures and guidelines, the following recommendations are being made to address the above noted issues of concern.

Immediate:

i. Re-establish and ensure flow in East Creek by removing any obstructions (e.g. beaver dams).

ii. Prior to impending (November 2005) cell 2 discharge, redirect raw sewage input to cell 1. Discharge cell 2 over a period of 7 days. Once discharge is complete, redirect raw sewage back to cell 2 and cease continuous discharge from cell 1.

Medium-term (within 1 year):

iii. Assess alternatives to reduce possibility of East Creek flow into Red Willow Creek, (e.g. install barrier in southern terminus of East Creek).

iv. Operate and maintain the sewage treatment facility in accordance with the Operations Manual (e.g. seasonal, 7-day discharge schedule, pre-discharge survey of East Creek).
v. Develop and implement a contingency plan to be used in the event of backflow of lagoon effluent into Red Willow Creek (e.g. procedures for notification and evaluation of potential disinfection of the lagoon discharge).
vi. Assess and repair the breach and overflow pipe within the berm separating the two cells.

Long-term (within 2 years):
vii. Consider an alternate discharge strategy to reduce the risk of flow into Red Willow Creek (e.g. alternate receiver of lagoon discharge).
viii. Review the Operations Manual and update regularly (e.g. directions for regular inspections of the facility by operators, retention of appropriate monitoring records, and formalization of reporting mechanism).
ix. Develop and implement an Operator Training Program.
x. Develop and implement a Preventative Maintenance Program.
xi. Develop and implement a sampling and monitoring program for the lagoon cells, lagoon effluent, East Creek and Red Willow Creek. It is recommended that flow measuring be undertaken as part of this monitoring program.

APPENDIX C:

Tables and Figures Supporting the Technical Assessments

Figure 1: Location of Kashechewan First Nation

Figure 2: Kashechewan First Nation and Surrounding Area

Figure 3: Process Flow Diagram - Kashechewan Water Treatment Plant

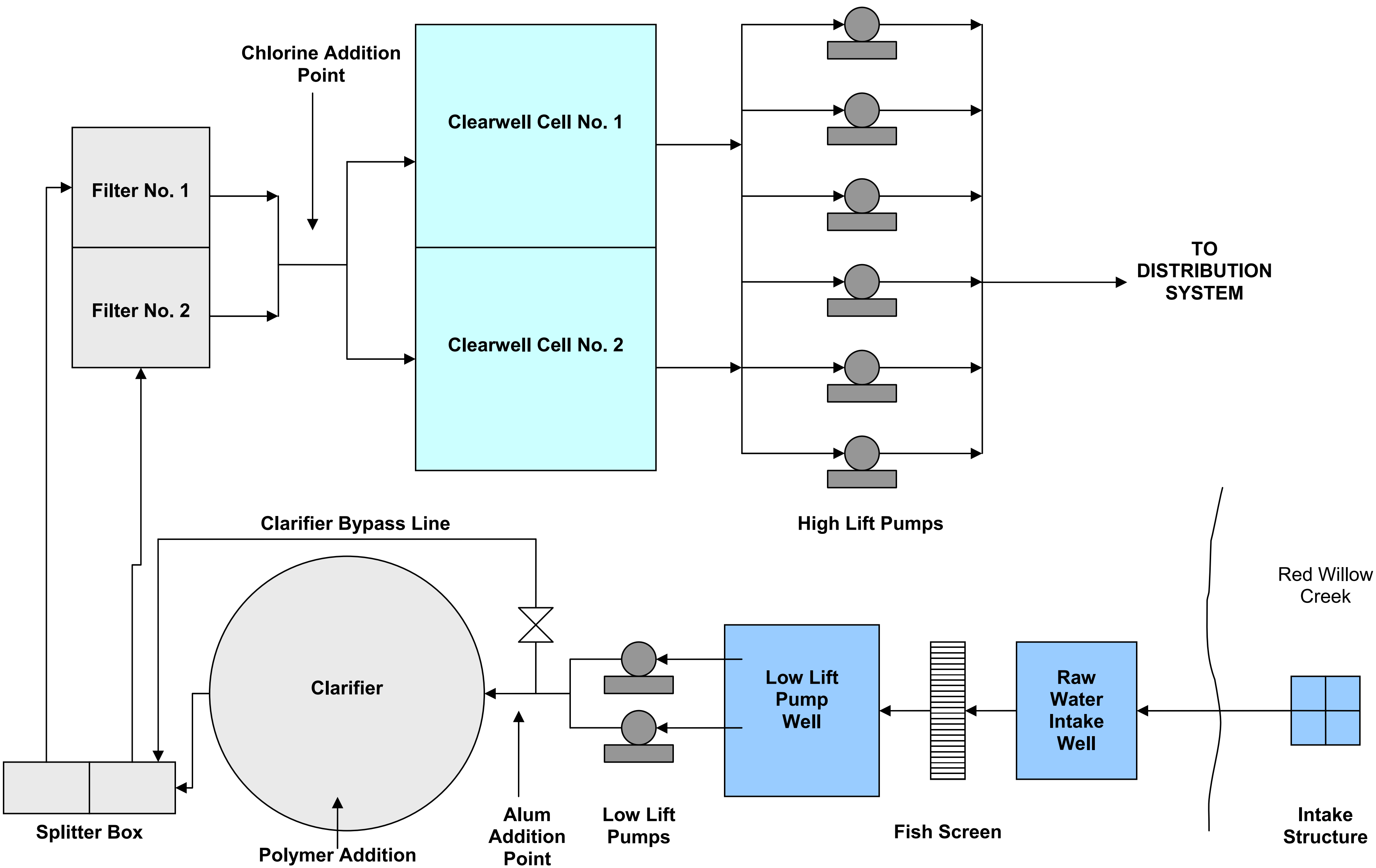
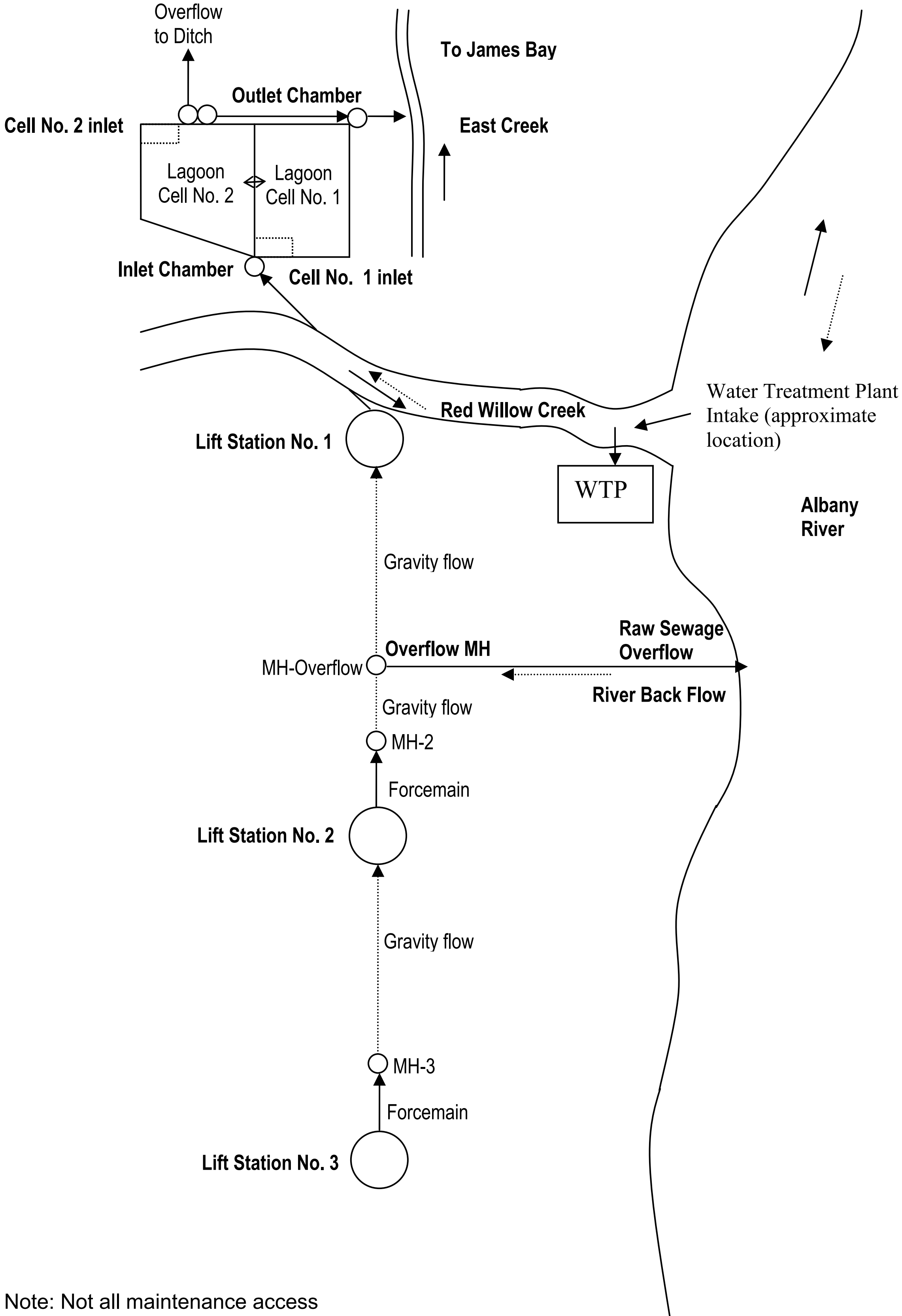


Figure 4: Schematic View - Kashechewan Water Treatment Plant and Sewage Collection & Treatment System



Note: Not all maintenance access holes are marked

Figure 5: Sewage Treatment Facility - General Layout

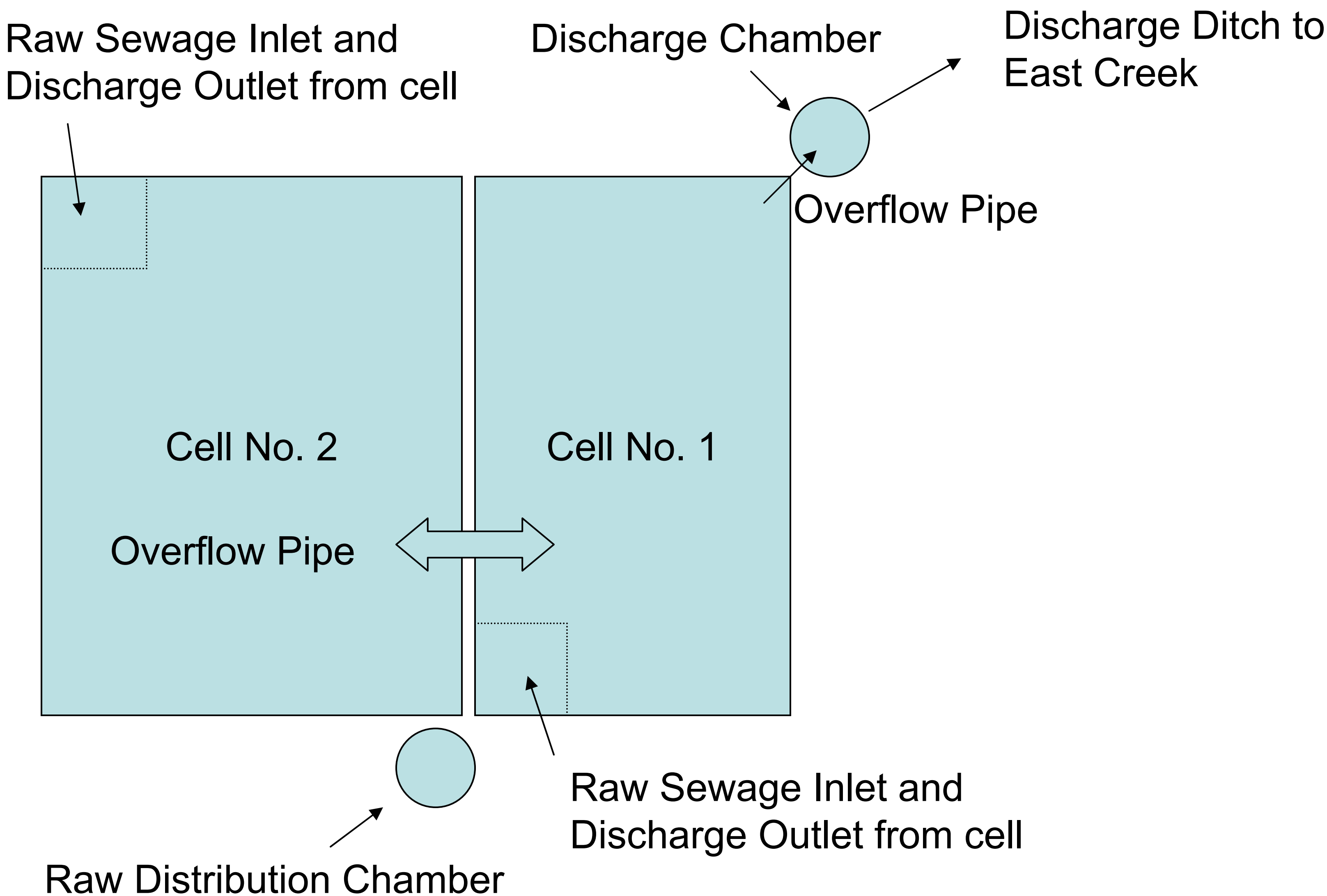


Figure 6: East Creek to James Bay

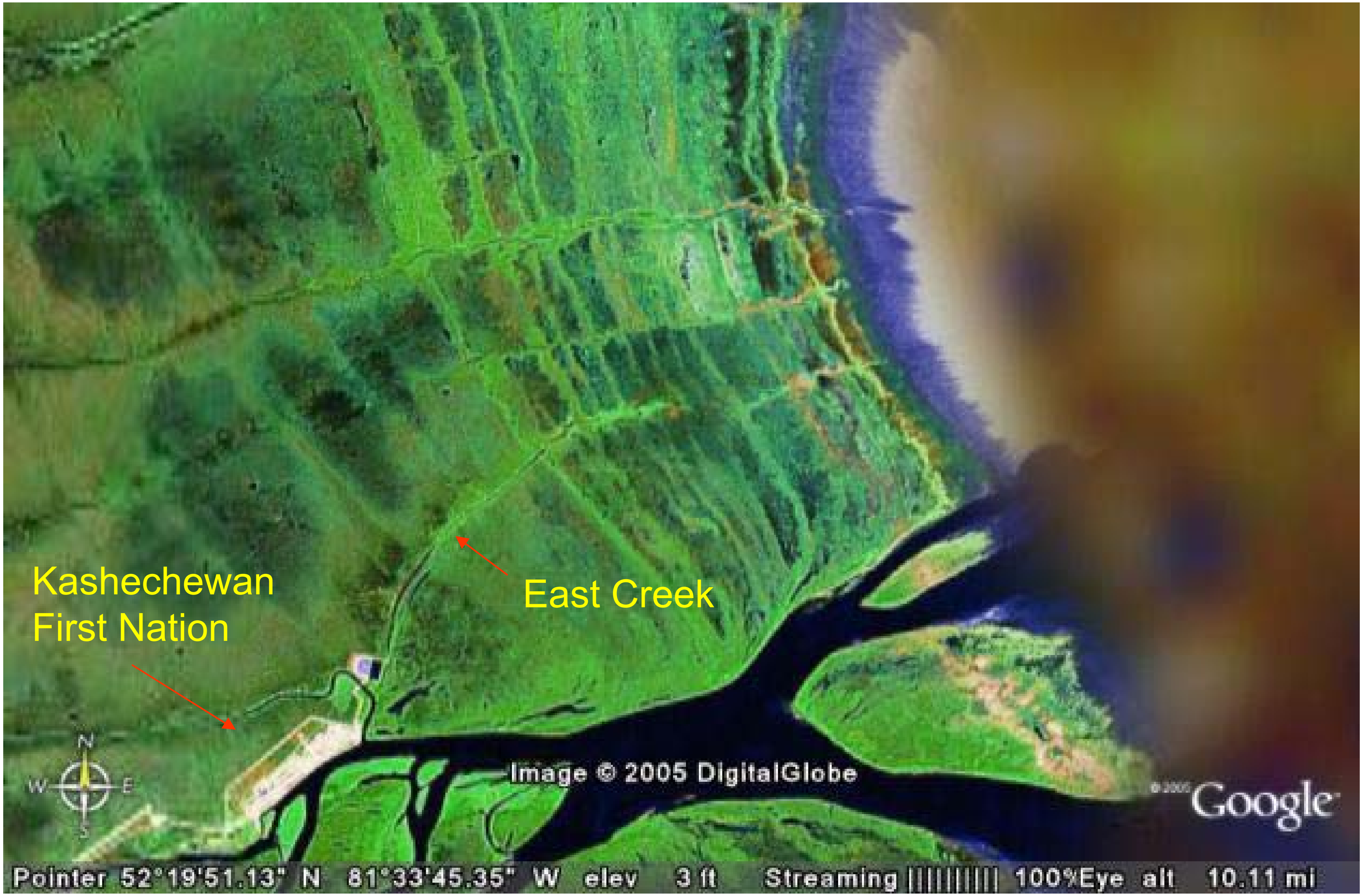


Table 1: Typical Ontario Sampling of Seasonally Discharge Sewage Treatment Lagoons

Frequency	Location	Parameters
Monthly	Raw Sewage	BOD_5, Total Suspended Solids, Total Phosphorus[1]
Pre-Discharge	Lagoon	BOD5, Total Suspended Solids, Total Phosphorus[1], Total Kjeldahl Nitrogen[1] H_2S[1], Dissolved Oxygen[1]
During Discharge[2]	Final Effluent	BOD5, Total Suspended Solids, Total Phosphorus, Ammonia + Ammonium Nitrogen[1], Total Kjeldahl Nitrogen[1] Nitrate Nitrogen[1], Nitrate Nitrogen[1] H_2S[1]

[1]As Required.

[2]Minimum of two samples per week of discharge. Typically samples obtained at the beginning, middle and end of the discharge period.

Table 2: Kashechewan First Nation Sewage Treatment Facility
Water Quality Review, 2000 - 2005 (as available)

		Health Canada						MOE		Effluent Criteria		
		Cell 1	Cell 1 North			Cell 1 Effluent		Cell 1[2]	Cell 2	Federal[3]	Provincial[4]	
Parameters	**Units**	**05/30/00**	**06/06/01**	**06/05/02**	**5/28/03**	**10/28/04**	**10/2/05**	**10/29/05**	**10/29/05**	**Guideline**	**Objective[5]**	**Guideline[6]**
BOD_5 (5-day Biochemical Oxygen Demand)	mg/l	9	13	28	13	9	13	0.6	0.8	20	25	30
Phenol	mg/l	<0.002	0.004	0.007	0.003	0.012	0.023	…..	…..	20	na	na
Total Phosphorous[1]	mg/l	0.51	0.37	0.39	0.32	0.16	0.21	0.25	0.2	1	na	na
Total Suspended Solids	mg/l	21	17	25	16	9	23	12.8	19.4	25	30	40
TKN (Total Nitrogen)	mg/l	7.8	11.1	….	10.9	15.1	10.5	7.11	11.3	na	na	na

[1]Some Health Canada results referred to Total Phosphate rather than Total Phosphorous. However, the guideline remained the same. All results were therefore treated as Total Phosphorous.

[2]Sample taken from discharge chamber.

[3]Health Canada Correspondence

[4]Ministry of the Environment Procedure F-5-1 "Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters.

[5]Expected effluent quality under optimum conditions when treating raw sewage with BOD_5 = 170 mg/l, soluble BOD_5 = 50%, SS=200 mg/l, TP=7 mg/l, (NH3 + NH4+)-N=20 mg/l

[6]Criteria which the average annual effluent quality should not exceed (based upon performance data collected in 1983 of sewage treatment works in operation in Ontario).

APPENDIX D:

Analytical Results of Water Quality Tests

KASHECHEWAN SAMPLE ANALYSIS REPORTS
Sample Locations

Kashechewan Drinking Water System Assessment
Sampling Program

	Sample Site	Sample Site Description	Location (GPS NAD83)
1	PC-T	Treated Water - Kashechewan WTP	17UO457112/5794047
2	PC-R	Raw Water - Kashechewan WTP intake	17UO457112/5794047
3	PC-D11	D. Wynn residence - distribution	17UO456306/5793759
4	PC-D12	S. Koosees residence - distribution	17UO455918/5793123
5	PCD-13	D Lazerus residence - distribution	17UO456156/5793646
6	PCD-15	L Goodwin residence - distribution	17UO456591/5793842
7	PC-D16	I Wynn residence - distributrion	17UO457112/5794047
8	PC-D17	Nursing Station - distribution	17UO456306/5793759

Sewage Treatment Facility Assessment
Sampling Program

	Sample Site	Sample Site Description	Location (GPS NAD83)
1	RWK-UP	Red Willow Creek Upstream of Storm Water Overflow	17U0457195/5794130
2	RWK-DWN1	Red Willow Creek Downstream of Storm Water Overflow	17U0457199/5794106
3	RWK-DWN2	Confluence of Red Willow Creek and Albany River	17U0457179/5793953
4	AR-UP	Albany River Upstream	17U0457168/5793951
5	KSTP-1	Raw Sewage from Distribution Chamber	17U0457272/5794847
6	KSTP-2	Cell 2, off berm	17U0457281/5795116
7	KSTP-3	Cell 1, from Discharge Chamber	17U0457483/5795075
8	KSTPDIS(4)	Confluence of East Creek and Discharge	17U0457521/5795070
9	KSTP-5	East Creek at Winter Road	17U0457449/5794768

Kashechewan Sewage/Surface Water Analysis

Bacteriological Analysis Results (Final October 30, 2005)

Sample Date	Sample ID	Sample Source	Lab ID	E. coli (CFU/100 ml)
29-Oct-05	KSTP - 1	Sewage Lagoon	3447826	$<10^3$
29-Oct-05	KSTP - 2	Sewage Lagoon	3447928	1.2×10^3
29-Oct-05	KSTP - 3	Sewage Lagoon	3447825	$<10^3$
29-Oct-05	KSTP - 4	Sewage Lagoon	3447832	$<10^3$
29-Oct-05	KSTP - 5	Sewage Lagoon	3447964	$<10^3$
29-Oct-05	RWK-UP	Red Willow Creek	3447789	$<10^3$
29-Oct-05	RWK-DWN1	Red Willow Creek	3447758	$<10^3$
29-Oct-05	RWK-DWN2	Red Willow Creek	3447828	$<10^3$
29-Oct-05	AB-UP	Albany River	3447917	$<10^3$

KASHECHEWAN SAMPLE ANALYSIS REPORTS

Sample date: October 30, 2005		**Sewage Lagoon Samples**			**East Creek**		**Red Willow Creek**			**Albany River**
Parameter	**Units**	KSTP-1	KSTP-2	KSTP-3	KSTPDIS(4)	KSTP-5	RWK-UP	RWK-DWN1	RWK-DWN2	AR-UP
Arsenic	mg/l	0.002	0.0005	0.0005	0.0005	0.0005	0.005	0.005	0.0005	0.005
Selenium	mg/l	0.0005	0.0005	0.0005	0.0005	0.005	0.005	0.0005	0.0005	0.0005
Aluminum	mg/l	0.125	1.01	0.38	0.19	0.095	0.27	0.23	0.43	0.245
Barium	mg/l	0.016	0.009	0.009	0.018	0.011	0.01	0.016	0.016	0.016
Beryllium	mg/l	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cadmium	mg/l	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Calcium	mg/l	149	45.5	47.8	56.3	86.1	20.7	21.2	20.6	19.1
Chromium	mg/l	0.01	0.011	0.011	0.01	0.01	0.01	0.01	0.01	0.01
Cobalt	mg/l	0.005	0.044	0.061	0.006	0.005	0.005	0.005	0.005	0.005
Copper	mg/l	0.078	0.054	0.143	0.004	0.054	0.053	0.023	0.011	0.008
Iron	mg/l	0.076	1.06	1.03	0.59	0.765	0.598	0.476	0.703	0.387
Lead	mg/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Magnesium	mg/l	14.4	9.78	9.52	9.97	11.7	4.27	4.34	4.35	3.61
Manganese	mg/l	0.295	0.121	0.11	0.087	0.108	0.025	0.018	0.033	0.018
Molybdenum	mg/l	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Nickel	mg/l	0.01	0.01	0.014	0.01	0.01	0.01	0.01	0.01	0.01
Silver	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Strontium	mg/l	0.299	0.172	0.157	0.148	0.128	0.05	0.052	0.05	0.05
Titanium	mg/l	0.005	0.016	0.013	0.005	0.005	0.011	0.008	0.016	0.007
Vanadium	mg/l	0.005	0.045	0.06	0.005	0.005	0.005	0.005	0.005	0.005
Zinc	mg/l	0.053	0.13	0.048	0.023	0.043	0.024	0.054	0.018	0.021
Oxygen demand; BOD-carbonaceous	mg/l	1.6	0.8	0.6	0.7	0.9	7.4	9.5	2.3	0.7
Nitrogen; ammonia+ammonium	mg/l	0.05	7.87	3.64	1.61	0.002	0.002	0.002	0.002	0.002
Nitrogen; nitrite	mg/l	0.005	0.059	0.266	0.077	0.001	0.004	0.004	0.004	0.004
Nitrogen; nitrate+nitrite	mg/l	0.15	0.05	1.55	1.11	0.005	0.008	0.022	0.01	0.013
Phosphorus; phosphate	mg/l	0.02	0.02	0.02	0.0333	0.0005	0.0005	0.0005	0.0005	0.0005
Phosphorus; total	mg/l	0.02	0.2	0.25	0.121	0.032	0.031	0.013	0.018	0.012
Nitrogen; total Kjeldahl	mg/l	0.49	11.3	7.11	3.95	0.82	0.56	0.5	0.56	0.52
Oxygen demand; chemical	mg/l	18	124	74	40	33	73	60	57	53
Solids; suspended	mg/l	23.1	19.4	12.8	4	14.4	9.1	4.9	13.1	4.7
Mercury	ug/l	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
E. coli	CFU/100 ml	$<10^3$	1.2×10^3	$<10^3$	$<10^3$	$<10^3$	$<10^3$	$<10^3$	$<10^3$	$<10^3$

Kashechewan Drinking Water Analysis

Bacteriological Analysis Results (Final November 1, 2005)

Sample Date	Sample Time	Sample ID	Sample Source	Location	Lab ID	Bacteriological Analysis: Total Coliforms (CFU/100ml)	E. coli (CFU/100 ml)	HPC (limit 500 cfu/100ml)	Chlorine Residual (mg/l)
29-Oct-05	9:35	PC-1	Distribution	D Wynne	3447976	0	0	<10	1.18
29-Oct-05	10:10	PC-2	Distribution	S. Koosees	3447762	0	0	<10	1.34
29-Oct-05	10:20	PC-3	Distribution	D. Lazerus	3447779	0	0	<10	1.89
29-Oct-05	10:33	PC-4	Distribution	Northern Store	3447920	0	0	<10	1.32
29-Oct-05	10:50	PC-5	Distribution	L. Goodwin	3447972	0	0	<10	1.09
29-Oct-05	11:00	PC-6	Distribution	I Wynne	3447764	0	0	<10	1.33
29-Oct-05	11:31	PC-7	Distribution	Nursing Station	3447768	0	0	<10	1.89
30-Oct-05	9:25	PC-011	Distribution	D Wynne	3447974	0	0	<10	2.20
30-Oct-05	9:35	PC-012	Distribution	S. Koosees	3447985	0	0	<10	2.01
30-Oct-05	9:43	PC-013	Distribution	D Lazerus	3447844	0	0	<10	1.42
30-Oct-05	9:55	PC-015	Distribution	L. Goodwin	3447765	0	0	<10	2.20
30-Oct-05	10:04	PC-016	Distribution	I Wynne	3447981	0	0	<10	1.02
30-Oct-05	10:57	PC-T	Treated	Kashechewan WTP	3447953	0	0	<10	1.32
30-Oct-05	12:41	PC-017	Distribution	Nursing Station	3447846	0	0	<10	1.03

KASHECHEWAN SAMPLE ANALYSIS REPORTS

Sample date: October 30, 2005 — **Drinking Water Samples**

SWIPENHANCED Parameters (excluding microbiology)

LIMS Product	Parameter	O.Reg. 169 Limits (mg/l)	Units	Raw (PC-R)	Treated (PC-T)	PC-D11	PC-D12	PC-D13	PC-D15	PC-D16	PC-D17
	Nitrogen; nitrite	1	mg/l	0.002000	0.001						
	Nitrogen; nitrate+nitrite	10	mg/l	0.009000	0.014						
F3172	Fluoride	1.5	mg/l	0.030000	0.01						
	Cadmium	0.005	mg/l	0.000000	0.00004						
	Chromium	0.05	mg/l	0.002600	0.0023						
	Lead	0.01	mg/l	0.000024	0.00017	0.00101	0.00009	0.00124	0.00015	0.00006	0.00012
	Barium	1	mg/l	0.008170	0.00635						
	Uranium	0.02	mg/l	0.000060	0.00001						
	Boron	5	mg/l	0.010000	0.007						
	Arsenic	0.025	mg/l	0.000700	0.0002						
	Selenium	0.01	mg/l	0.000000	0						
	Antimony	0.006	mg/l	0.000270	0.00024						
HG3060	Mercury	0.001	mg/l	0.000020	0.00002						
VOL3144	Chloroethene (vinyl chloride)	0.002	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	1,1-Dichloroethene	0.014	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	Dichloromethane	0.05	mg/l	0.000200	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	1,2-Dichloroethane	0.005	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	Carbon Tetrachloride	0.005	mg/l	0.000200	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	Benzene	0.005	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	Trichloroethene	0.05	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	1,4-Dichlorobenzene	0.005	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	1,2-Dichlorobenzene	0.2	mg/l	0.000050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
	Trihalomethanes; total (averaged over 4 quarters)	0.1	mg/l	0.007000	0.057	0.09	0.07	0.069	0.108	0.059	0.07
CPA3119	2,4-Dichlorophenol	0.9	mg/l	0.002000	0.002						
	2,4,6-Trichlorophenol	0.005	mg/l	0.000020	0.00002						
	Dicamba	0.12	mg/l	0.000050	0.00005						
	2,3,4,6-Tetrachlorophenol	0.1	mg/l	0.000020	0.00002						
	Bromoxynil	0.005	mg/l	0.000050	0.00005						
	2,4-Dichlorophenoxy acetic acid [2,4-D]	0.1	mg/l	0.000100	0.0001						
	Pentachlorophenol [PCP]	0.06	mg/l	0.000010	0.00001						
	2,4,5-Trichlorophenoxy acetic acid [2,4,5-T]	0.28	mg/l	0.000050	0.00005						
	Dinoseb	0.01	mg/l	0.000020	0.00002						
	Picloram	0.19	mg/l	0.000100	0.0001						
	Diclofop-methyl	0.009	mg/l	0.000100	0.0001						
OPS3438	Aldicarb	0.009	mg/l	0.002500	0.0025						
	Carbofuran	0.09	mg/l	0.002000	0.002						
	Bendiocarb	0.04	mg/l	0.001500	0.0015						
	Carbaryl [Sevin]	0.09	mg/l	0.000200	0.0002						
	Triallate	0.23	mg/l	0.001500	0.0015						
	Diuron	0.15	mg/l	0.002000	0.002						

SWIPENHANCED Parameters (excluding microbiology)		O.Reg. 169 Limits (mg/l)	Units	Raw (PC-R)	Treated (PC-T)	PC-D11	PC-D12	PC-D13	PC-D15	PC-D16	PC-D17
LIMS Product	Parameter										
	Dieldrin		mg/l	0.000002	0.000002						
	Aldrin		mg/l	0.000001	0.000001						
	Aldrin + Dieldrin	0.0007	mg/l	0.000003	0.000003						
	Trifluralin	0.045	mg/l	0.000005	0.000005						
	g -BHC [Lindane]	0.004	mg/l	0.000001	0.000001						
	Chlorodane:Total	0.007	mg/l	0.000006	0.000006						
	p,p'-DDE		mg/l	0.000002	0.000002						
	o,p'-DDT		mg/l	0.000005	0.000005						
	p,p'-DDD		mg/l	0.000005	0.000005						
	p,p'-DDT		mg/l	0.000005	0.000005						
	DDT:Total	0.03	mg/l	0.000017	0.000017						
	Methoxychlor	0.09	mg/l	0.000005	0.000005						
	Heptachlor		mg/l	0.000001	0.000001						
	Heptachlor epoxide		mg/l	0.000002	0.000002						
	Heptachlor + Heptachlor epoxide	0.003	mg/l	0.000003	0.000003						
	Total PCBs	0.003	mg/l	0.000020	0.00002						
	Benzo(a)pyrene	0.00001	mg/l	0.000001	0.000001						
	Simazine	0.01	mg/l	0.000050	0.00005						
	Atrazine		mg/l	0.000050	0.00005						
	Metribuzin [Secor]	0.08	mg/l	0.000100	0.0001						
	Alachlor [Lasso]	0..5	mg/l	0.000500	0.0005						
	Prometryne	0.001	mg/l	0.000050	0.00005						
	Metolachlor	0.05	mg/l	0.000500	0.0005						
	Cyanazine [Bladex]	0.01	mg/l	0.000100	0.0001						
	Atrazine +de-alkylatedatrazine	0.005	mg/l	0.000200	0.0002						
OPS3437	Dimethoate	0.02	mg/l	0.000500	0.0005						
	Azinphos-methyl [Guthion]	0.02	mg/l	0.000050	0.00005						
	Malathion	0.019	mg/l	0.000500	0.0005						
	Parathion	0.05	mg/l	0.000100	0.0001						
	Diazinon	0.02	mg/l	0.000200	0.0002						
	Phorate [Thimet]	0.002	mg/l	0.000100	0.0001						
	Terbufos	0.001	mg/l	0.000200	0.0002						
	Temephos [Abate]	0.28	mg/l	0.000100	0.0001						
	Chlorpyrifos [Dursban]	0.09	mg/l	0.000100	0.0001						
GLY3415	Glyphosate	0.28	mg/l	0.002000	0.002						
PAR3417	Diquat	0.07	mg/l	0.000100	0.0001						
	Paraquat	0.01	mg/l	0.000100	0.0001						
BROM3434	Bromate	0.01	mg/l	0.000300	0.0002						
NTA3406	Nitrilotriacetic Acid	0.4	mg/l	0.000010	0.00001						

APPENDIX E:

List of Documents Provided to the Ministry of the Environment

Drinking Water System

- XCG Consultants Limited report prepared as correspondence dated June 30, 2003, August 12, 2003, December 31, 2003, March 5, 2004 and April 12, 2004.

- OCWA correspondence dated September 24, 2004.

- Contact specifications for “Instrumentation and Control Upgrades” prepared by J.L. Richards dated October 2005

- Northern Waterworks Inc. report dated October 25, 2005 and “Initial Report” (not dated)

- Contract Drawings prepared by J.L. Richards & Associates Limited for the Water Treatment Plant and Sewage Collection and Water Distribution system.

Sewage Collection and Treatment System

- December 9, 1999 facsimile from Anishinabek Engineering Ltd. to Health Canada regarding Addendum Number 3, Project Number 299035

- “Condition Survey Report Kashechewan Sewage Lagoons” December 2002, prepared by J.L. Richards & Associates Limited, for the Kashechewan First Nation

- “Kashechewan First Nation Waste Stabilization Ponds Operations Manual” dated December 4, 2002, prepared by B.H. Martin Consultants Ltd. for the Kashechewan First Nation (referenced in Technical Assessment as Operations Manual)

- December 5, 2002 Letter from B.H. Martin Consultants Ltd. to Mr. Archie Wesley, Executive Director, Kashechewan First Nation

- December 18, 2002 Letter from B. H. Martin Consultants Ltd. to Mr. Archie Wesley, Executive Director, Kashechewan First Nation

- “Visual Review Kashechewan Sewage Lagoon” December 2003 prepared by J.L. Richards & Associates Limited for Ontario Clean Water Agency

- April 12, 2004 Letter from XCG Consultants Ltd. To Ontario Clean Water Agency

- “Engineering Assessment Kashechewan First Nation Water System Kashechewan, Ontario” prepared March 5, 2004 by XCG Consultants Ltd., for Ontario Clean Water Agency

- Health Canada correspondence to Kashechewan First Nation dated October 18, 2005; November 22, 2004; June 28, 2004; June 26, 2003 (2); June 26, 2002; June 15, 2001; June 26, 2000

APPENDIX F:

Ontario Acts, Regulations, Guidelines, Policies and Procedures Referenced by the Expert Technical Team, Ministry of the Environment

Legislation

- *Safe Drinking Water Act, 2002* (SDWA)
- *Ontario Water Resources Act, R.S. O. 1990* (OWRA)
- *Environmental Protection Act, R.S.O. 1990* (EPA)

Regulations

- *Certification of Drinking-Water Systems Operators and Water Quality Analysts Regulation* (O.Reg. 128/04)
- *Drinking Water Systems Regulation* (O.Reg. 170/03)
- *Drinking-Water Testing Services Regulation* (O.Reg. 248/03)
- *Licensing of Sewage Works Operators* (O.Reg 129/04)
- *Ontario Drinking-water Quality Standards* (O.Reg. 169/03)
- *Water Works and Sewage Works* (O. Reg. 435/93)

Related Ministry Policies and Procedures

- **Guideline F-5** Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters
- **Guideline F-10** Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works
- MOE guideline of 1984 titled “Guidelines for the Design of Sewage Treatment Works”.

- Notice of Adverse Test Results and Other Problems and Notice of Issue Resolution at Drinking-Water Systems (January 2005) (as required by Ontario Regulation 170/03)

- Procedure for Disinfection of Drinking Water in Ontario (as adopted by reference by Ontario Regulation 170/03 under the *Safe Drinking Water Act*)

- **Procedure F-5-1** Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters

- **Procedure F-5-2** Relaxation of Normal Level of Treatment for Municipal and Private Sewage Works Discharging to Surface Waters

- **Procedure F-5-3** Derivation of Sewage Treatment Works Effluent Requirements for the Incorporation of Effluent Requirements into Certificates of Approval for New or Expanded Sewage Treatment Works

- **Procedure F-5-4** Effluent Disinfection Requirements for Sewage Works Discharging to Surface Waters

- **Procedure F-5-5** Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems

- **Procedure F-10-1** Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only)

- Recommended Standards for Waterworks “10 State Standards”

- Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (Ministry of the Environment, June 2003)

- Preparation of Sewage Inspection Reports (Ministry of the Environment, October 22, 2001)

APPENDIX G:

Members of the Ministry of the Environment's Technical Team

Jim Smith – Team Lead
Chief Drinking Water Inspector for Ontario and Assistant Deputy Minister, Drinking Water Management Division

- Oversight responsibility of Ontario's regulatory programs for safeguarding Ontario's drinking water and responsible for public reporting of drinking water quality in the province
- Over 20 years experience with the Ministry of the Environment in risk assessment, environmental standards for air, water and soil; pesticides management; and the assessment of environmental technologies

Girish Mehta, P.Eng. – Drinking Water System Design/Treatment Expert
Senior Water Engineer

- 17 years experience with the ministry, specializing in the fields of water and waste water
- Worked at consulting engineering firms in Ontario and Alberta for 16 years, focusing on the design and construction of municipal water and sewage works

Paul Croisier – Drinking Water Operations Expert
Drinking Water Inspector

- Over 18 years experience in the environmental field, including 15 years experience as a water and wastewater treatment operator
- Possesses Water Treatment Operator Class 3 Certification and sampling and monitoring expertise

Carroll Leith – Sewage System Operations Expert
Senior Environmental Officer

- 15 years education and work experience in the environmental field, 5 as a Senior Environmental Officer
- Regularly undertakes inspections and identifies deficiencies in the structure and operations of sewage treatment facilities
- Has extensive experience and knowledge of operations and inspections of a broad range of sewage systems

Zafar Bhatti, P.Eng. – Sewage Treatment Expert
Senior Review Engineer

- over 10 years professional experience in the environmental field
- Ph.D. in Environmental Engineering
- Extensive experience and research in the area of biological wastewater treatment